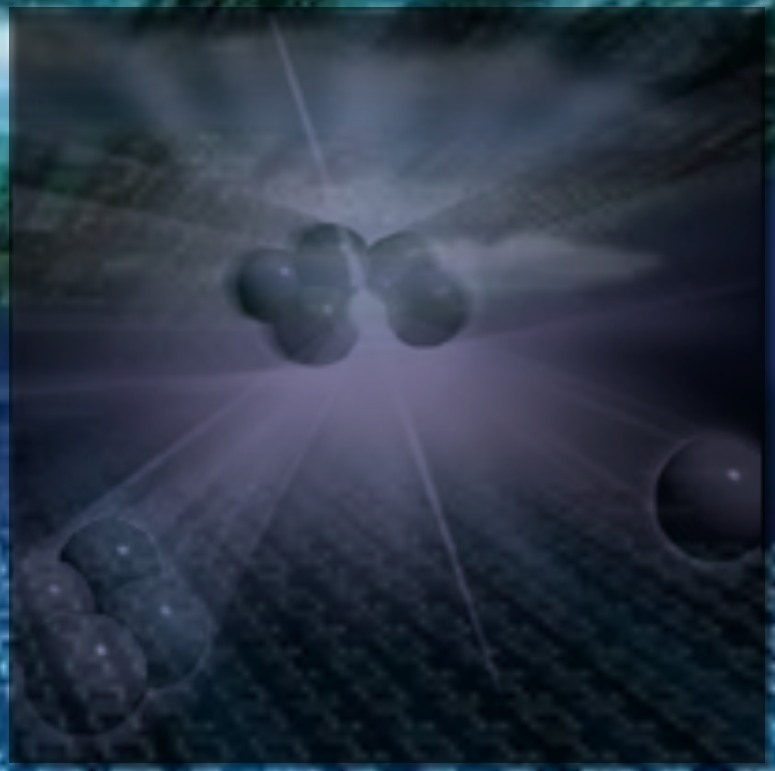
Cloud Computing for Nuclear Data



MICHAEL SMITH
PHYSICS DIVISION
OAK RIDGE NATIONAL LAB

summary

- IF
  - WE REALLY WANT THE BASIC & APPLIED NUCLEAR SCIENCE COMMUNITIES TO USE OUR CODES AND OUR DATA

summary

- IF
  - WE REALLY WANT THE BASIC & APPLIED NUCLEAR SCIENCE COMMUNITIES TO USE OUR CODES AND OUR DATA
- THEN
  - WE SHOULD DO EVERYTHING WE CAN TO MAKE IT EASY FOR THEM
  - RUN CODES ONLINE – NO NEED TO DOWNLOAD
  - MULTIPLE DATA FORMATS THAT THEY LIKE
  - ONLINE HELP, PIPELINES/GUIDES, LIVE SUPPORT
  - DISSEMINATION FROM MULTIPLE SOURCES
  - PROACTIVE EFFORTS TO HELP USERS …

summary

- IF
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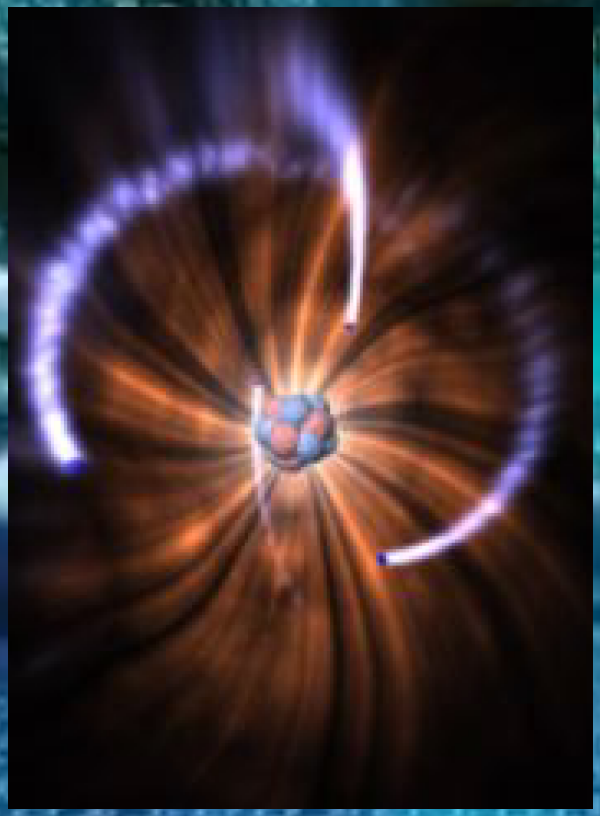
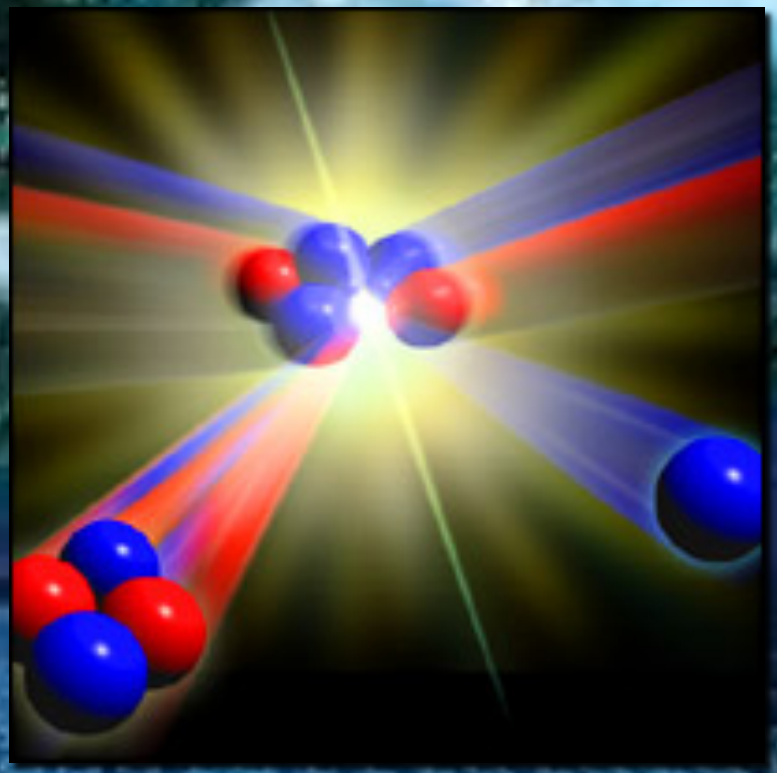
  - DISSEMINATION FROM MULTIPLE SOURCES
  - PROACTIVE EFFORTS TO HELP USERS …
- THIS CHANGE WILL ALSO HELP US DEAL WITH THE CRUSH OF NEW DATA

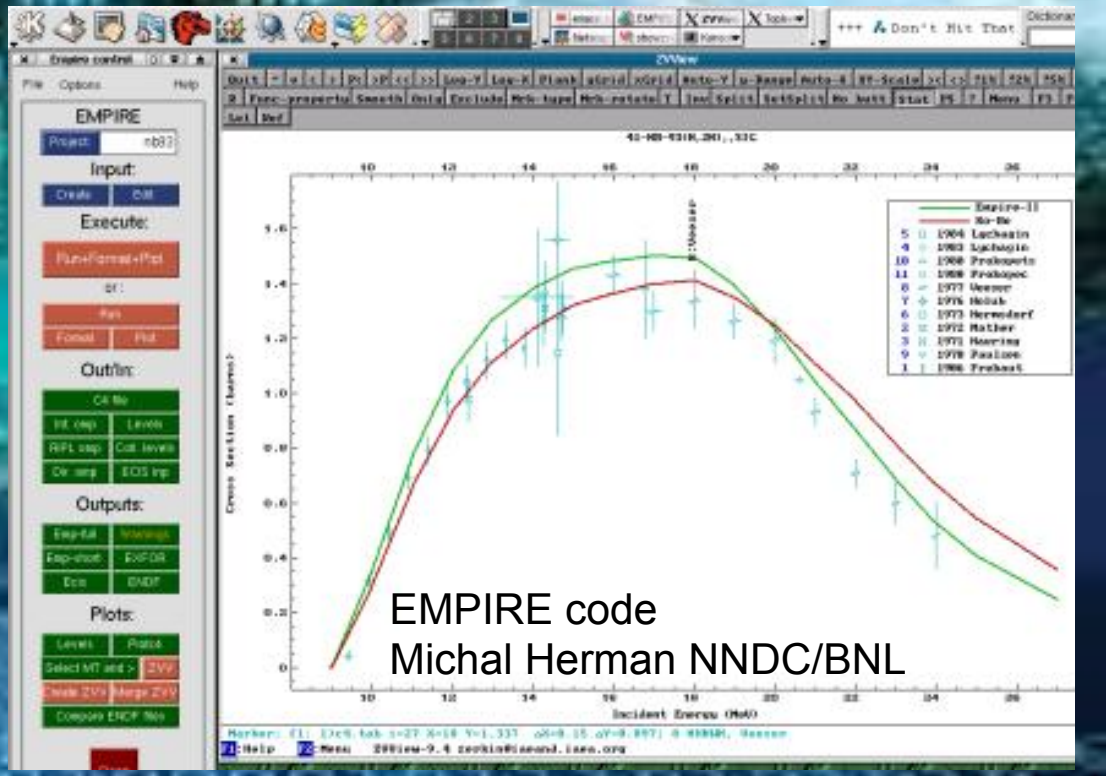
nuclear information





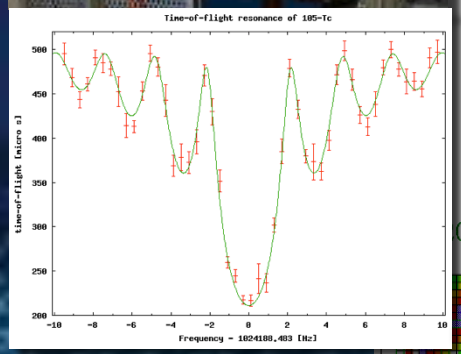
- STUDIES IN BASIC & APPLIED NUCLEAR SCIENCE REQUIRE BEST INFORMATION ON
  - STRUCTURE OF NUCLEI
  - REACTIONS BETWEEN NUCLEI

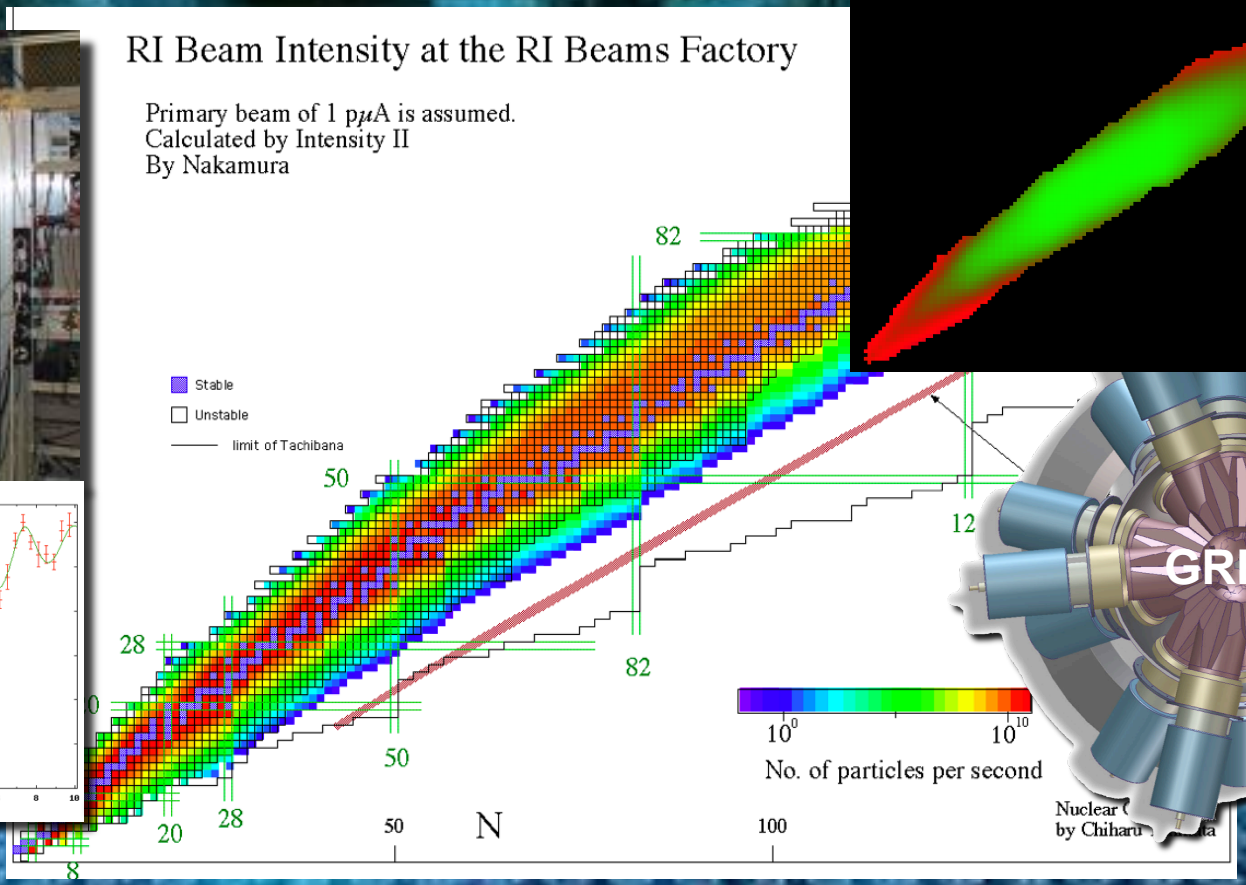
data generation and data processing



- IMPROVEMENTS REQUIRE EFFORTS IN BOTH
  - DATA GENERATION (MEASUREMENTS, THEORY)
  - DATA COMPILATIONS / EVALUATIONS / PROCESSING

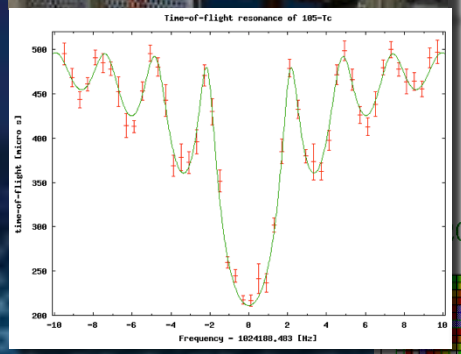
data generation and data processing

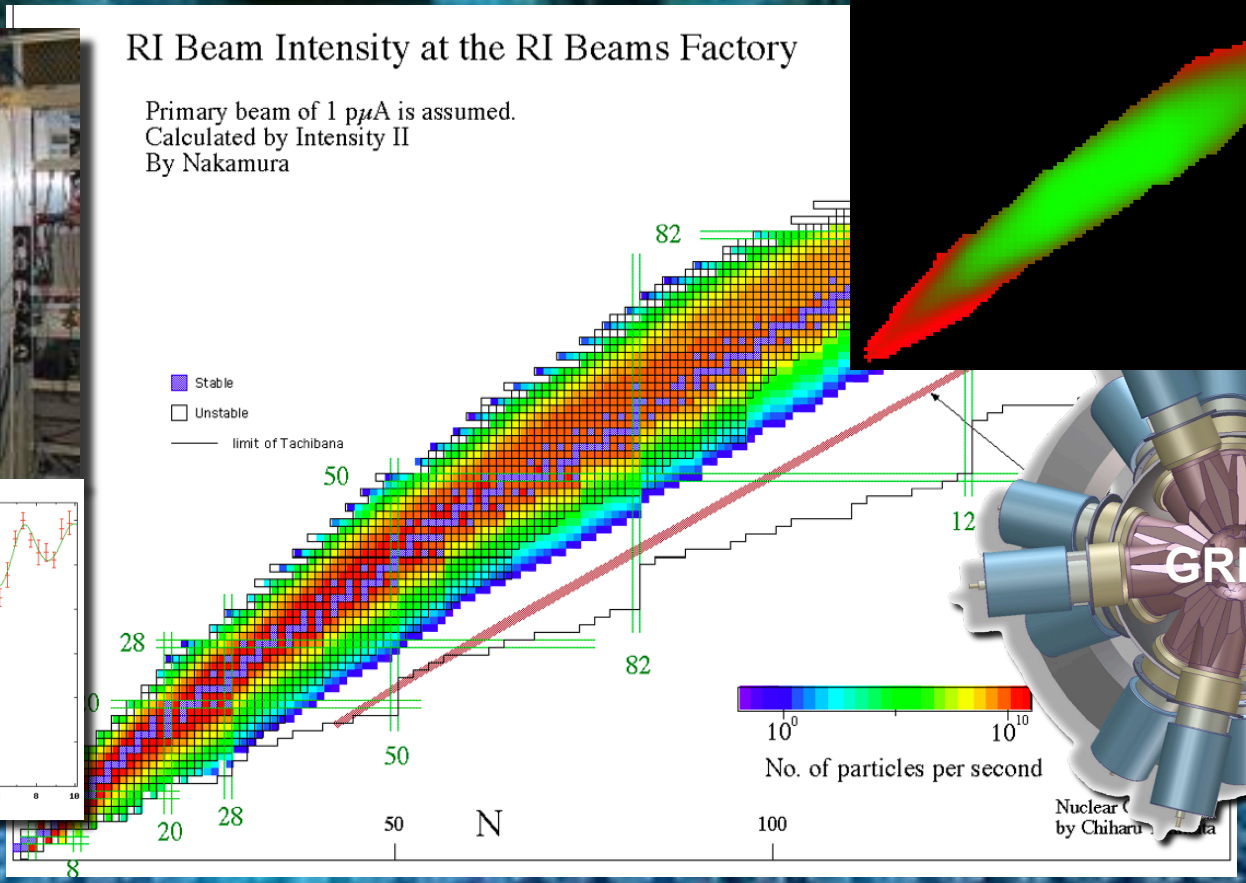




- DATA GENERATION RACING AHEAD, DRIVEN BY
  - LARGE DETECTOR ARRAYS
  - TRAPS FOR HIGH PRECISION MASS MEASUREMENTS
  - INTENSE BEAMS OF UNSTABLE NUCLEI [FRIB !]
  - SOPHISTICATED NUCLEAR MODELING CODES

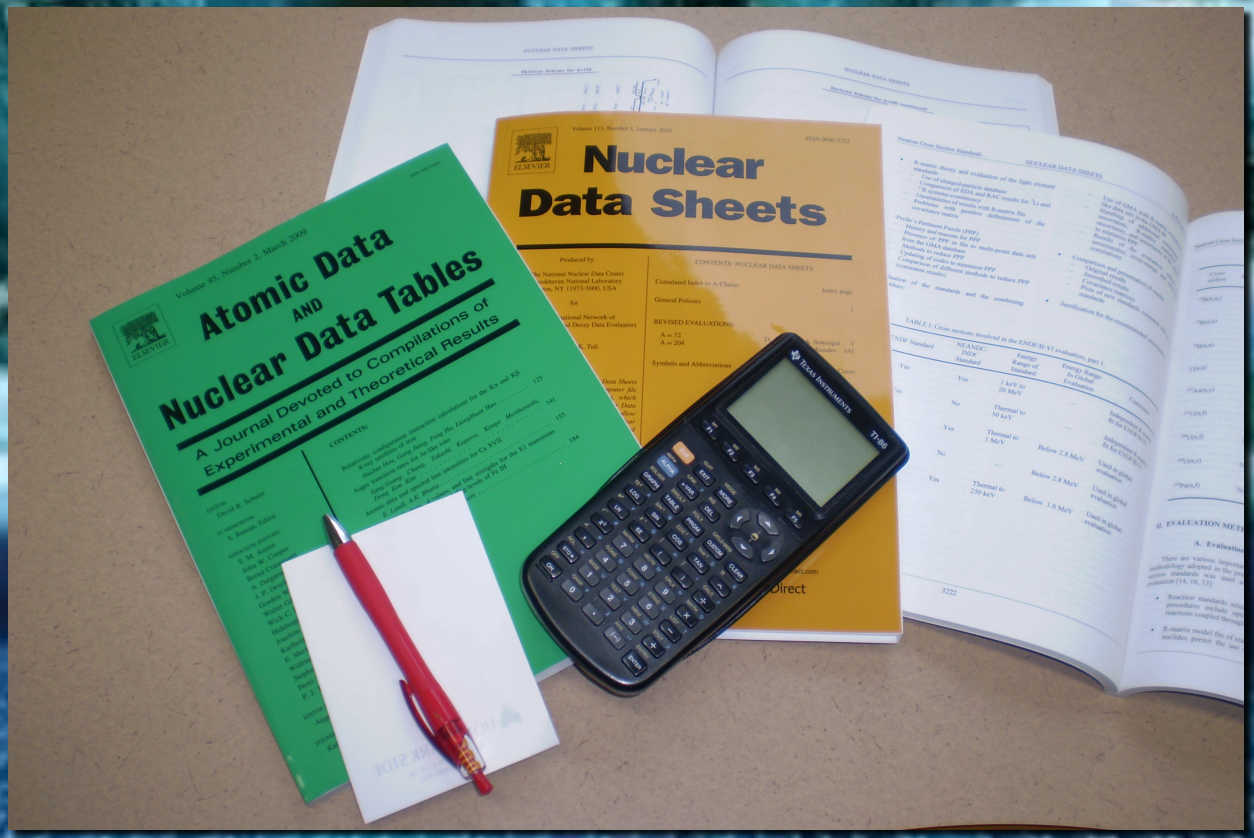
data generation and data processing





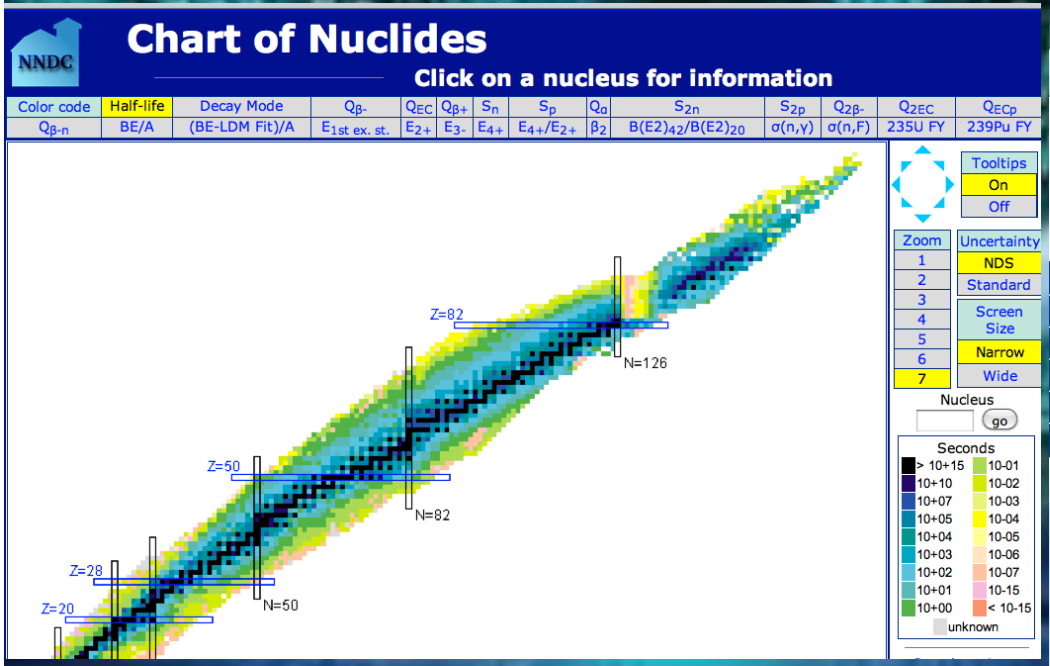
- DATA PROCESSING IS LAGGING BEHIND …
  - MASSES NOT FULLY UPDATED SINCE 2003 [AME2003]
  - MANY BETA DECAYS NOT YET IN ENSDF
  - CHARGED-PARTICLE INDUCED REACTIONS ON UNSTABLE NUCLEI NEED EVALUATIONS

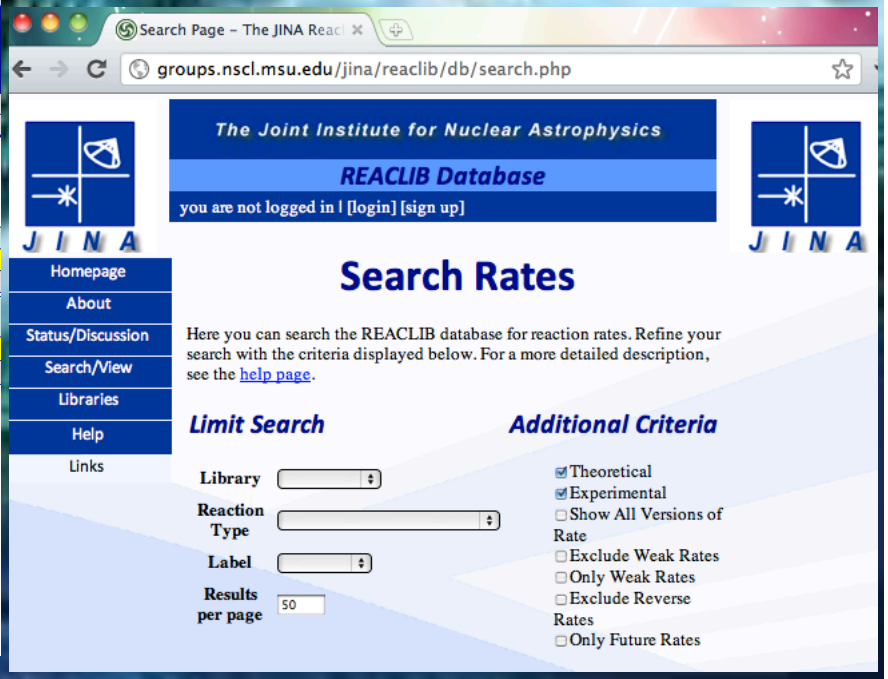
data generation and data processing



- WHY IS DATA PROCESSING LAGGING BEHIND ?
  - SHRINKING EVALUATION MANPOWER
  - MORE AND MORE DATA !
  - MORE COMPLEX DATA SETS
  - FEW CHANGES IN METHODOLOGY

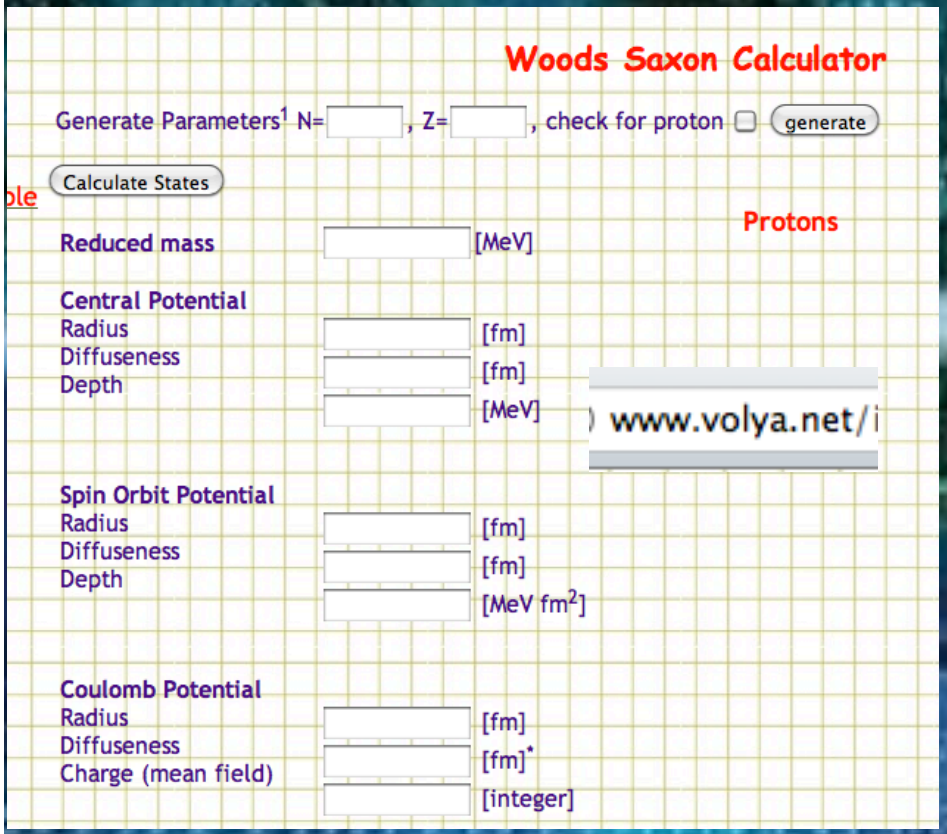
evaluation methodologies in nuclear science

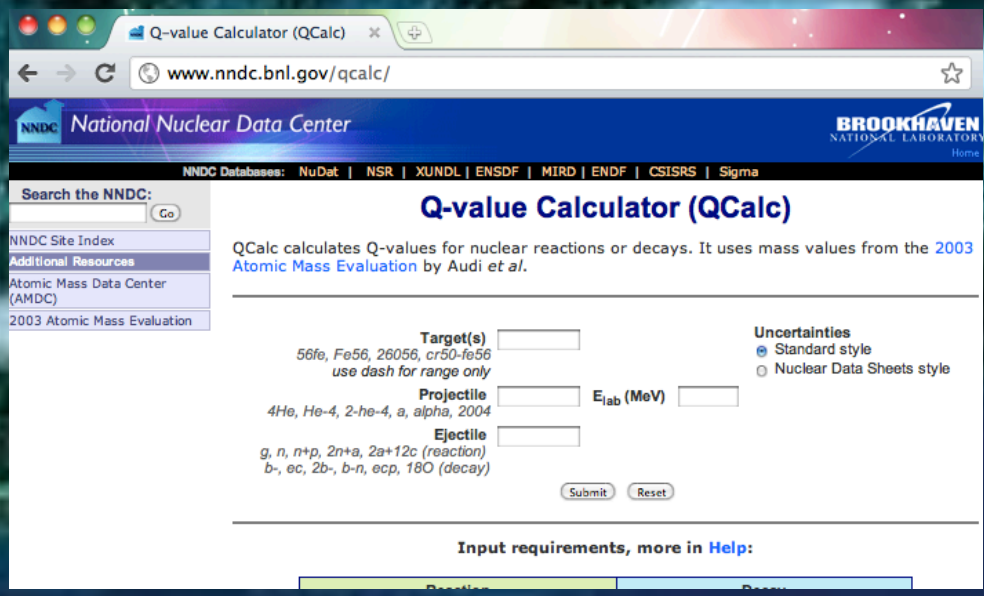


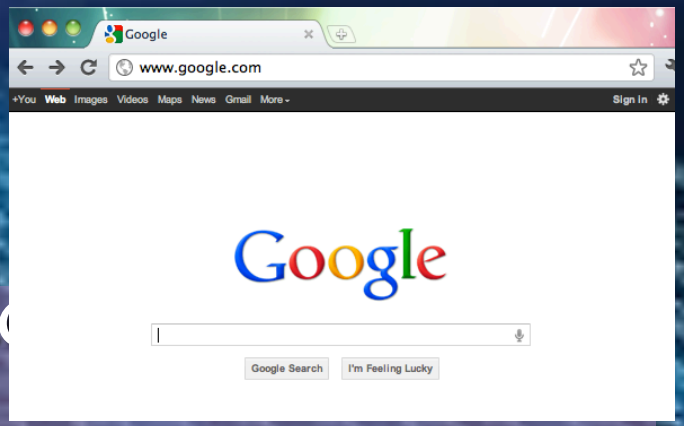


- THERE HAVE BEEN METHODOLOGY ADVANCES …
  - ONLINE DATABASES
  - NICE DATA VIEWERS
  - SOME ONLINE CODES
  - GOOGLE SEARCHES …

evaluation methodologies in nuclear science







- THERE HAVE BEEN METHODOL
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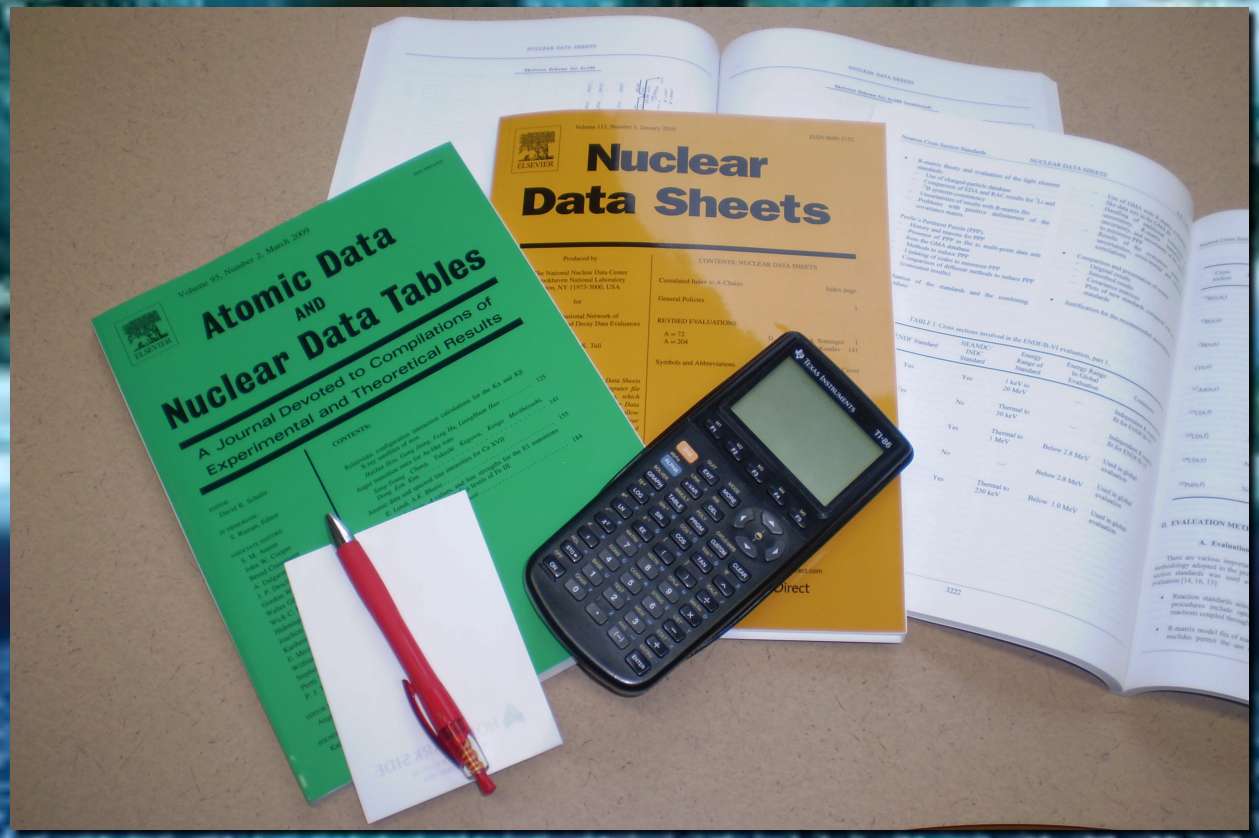
evaluation methodologies in nuclear science



- METHODOLOGY BREAKTHROUGHS ARE POSSIBLE - & NECESSARY TO KEEP UP WITH ALL THE NEW DATA !

evaluation methodologies in nuclear science

- NEED A PARADIGM SHIFT … NEW "ONLINE" APPROACH TO DATA WORK MAY BE THE ANSWER

new online paradigm

IMAGINE ...

HAVING A DIGITAL ASSISTANT WHO AUTOMATICALLY COLLECTS RELEVANT MASSES, LEVEL SCHEMES, REFERENCES ...

A WAY FOR EXPERTS TO EASILY UPLOAD SUPPLEMENTAL INFORMATION FOR YOUR EVALUATIONS

HAVING ALL MAJOR DATABASES JUST ONE MOUSE CLICK AWAY

HAVING AN EVALUATION TEMPLATE AUTOMATICALLY FILLED OUT FOR YOU

RUNNING ANALYSIS & APPLICATION CODES WITHOUT COMPATIBILITY, UPDATES, BACKUPS, OR CYBER SECURITY ISSUES

new online paradigm

IMAGINE ...

DESIGNING CUSTOM VIEWS OF DATASETS FROM A VARIETY OF VISUALIZATION TOOLS

HAVING A "VIRTUAL EXPERT" ONLINE 24/7 TO CONSULT WITH QUESTIONS

SHARING YOUR LARGE DATA SETS EASILY WITH COLLEAGUES

EASILY UPLOADING YOUR EVALUATION AND VISUALLY TRACKING ITS PROGRESS FOR REVIEWS, REVISIONS, & ACCEPTANCE

USING A PIPELINE TO PROCESS YOUR EVALUATED DATA FOR USE IN SIMULATIONS CODES

RUNNING & VISUALIZING THESE SIMULATIONS, THEN SHARING THE RESULTS WITH COLLEAGUES

new online paradigm

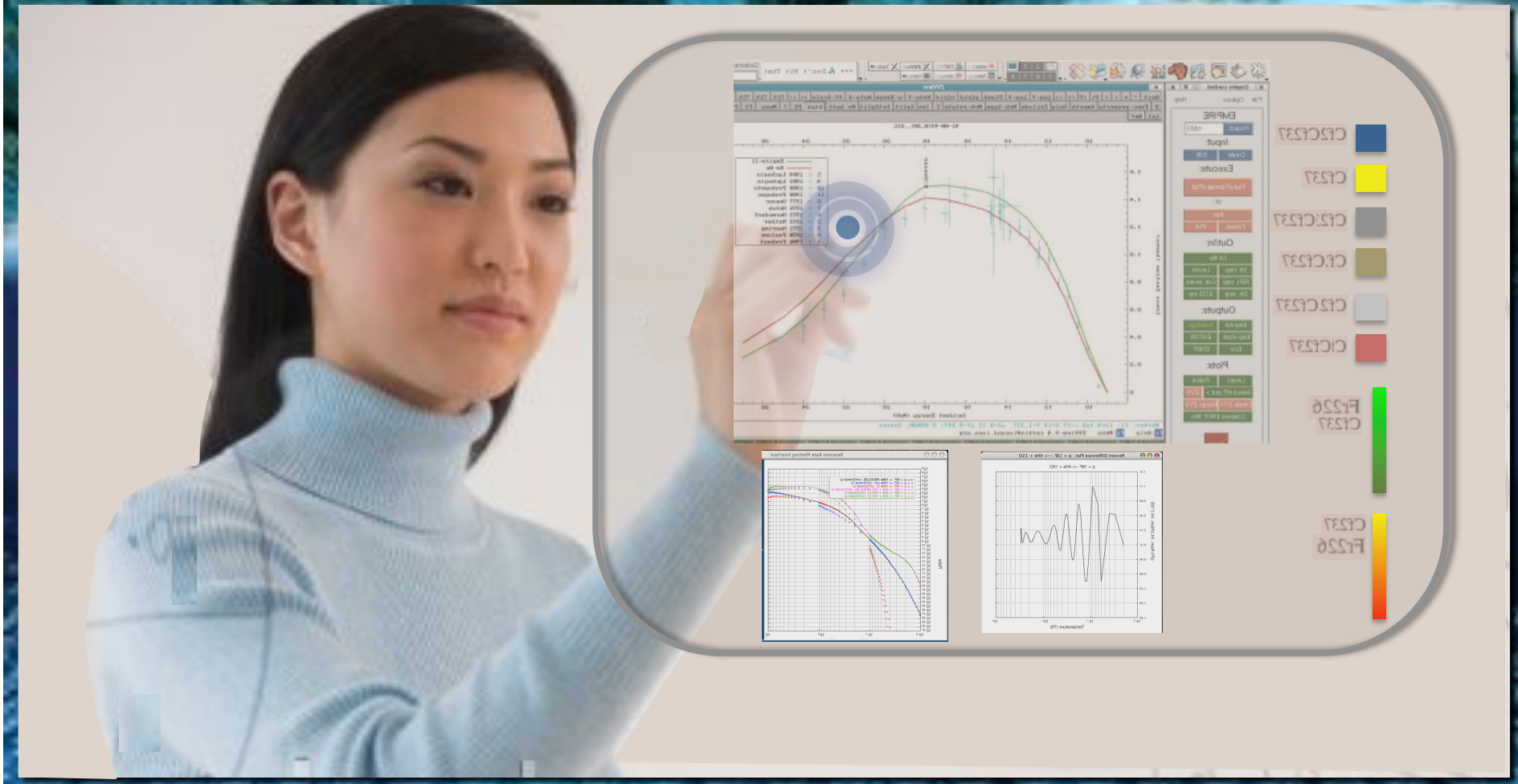
NOW IMAGINE ALL OF THESE SERVICES ARE FREE SUPPLEMENTS TO YOUR RESEARCH

YOU CAN PICK AND CHOOSE WHICH ONES TO USE

new online paradigm

- THIS NEW ONLINE WAY TO WORK NOT A WILD DREAM
  ... SOME COMPONENTS ARE ALREADY ONLINE !

new online paradigm



- WORKING ONLINE STREAMLINES REPETITIVE TASKS, GREAT FOR NOVICES OR EXPERTS, ATTRACTS STUDENTS …

cloud computing

- CLOUD COMPUTING: LATEST TREND IN SOFTWARE (GOOGLE APPS ...)
- RUN ON REMOTE SERVERS "IN THE CLOUDS"
- LET SOMEONE ELSE WORRY ABOUT MAINTENANCE, UPDATES, BACKUPS, SECURITY COSTS

cloud computing

- ADVANTAGES: NO ISSUES WITH PLATFORM COMPATIBILITY, COMPILATION ERRORS, INSTALLATION HASSLES TYPICAL OF CODE DOWNLOAD SERVICES

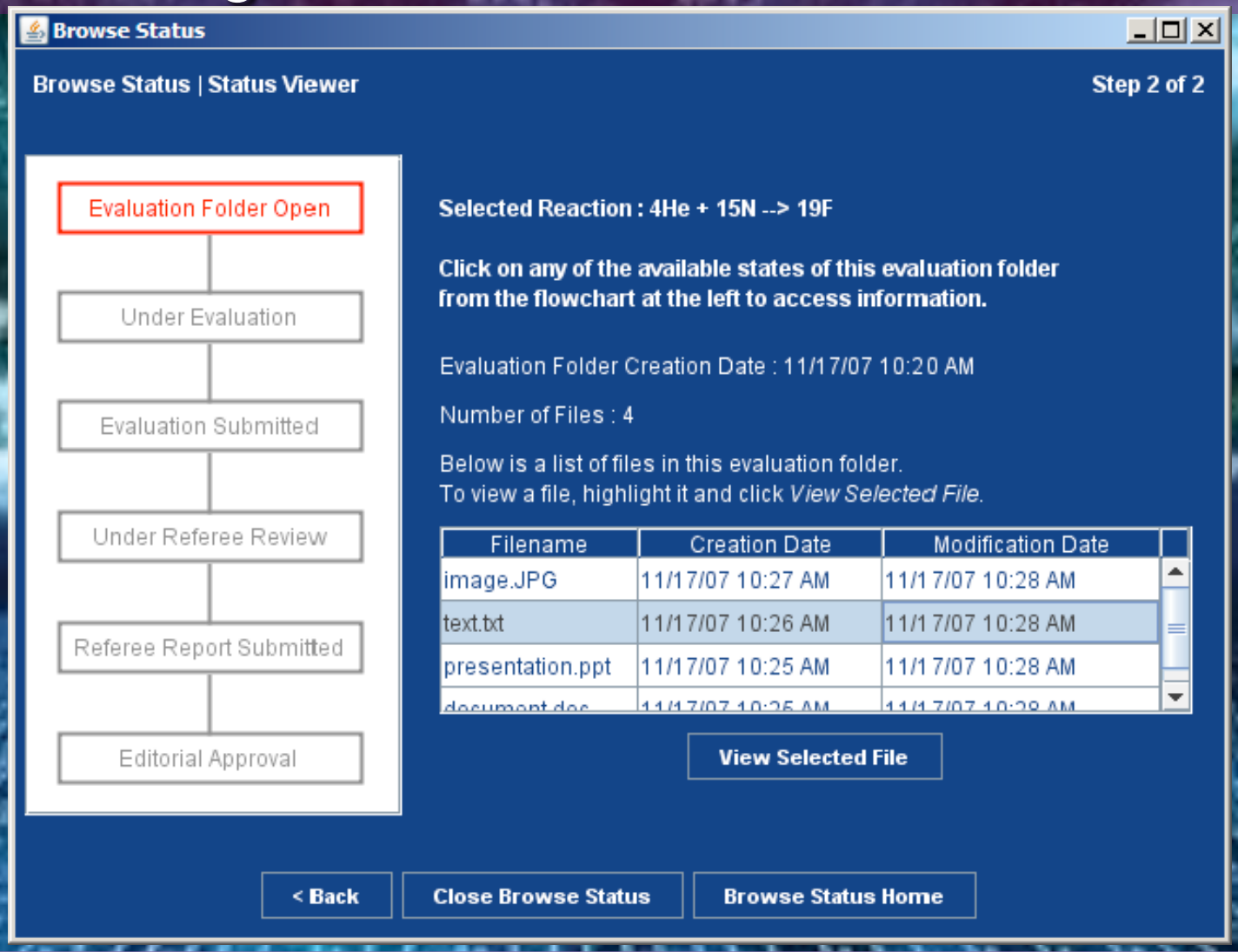
examples of first generation tools

- some first generation tools built & deployed
  - workflow management
  - virtual pipelines
  - online end-user applications
  - database access
  - file repository
  - data visualization
  - information sharing
  - data harvesting

workflow management

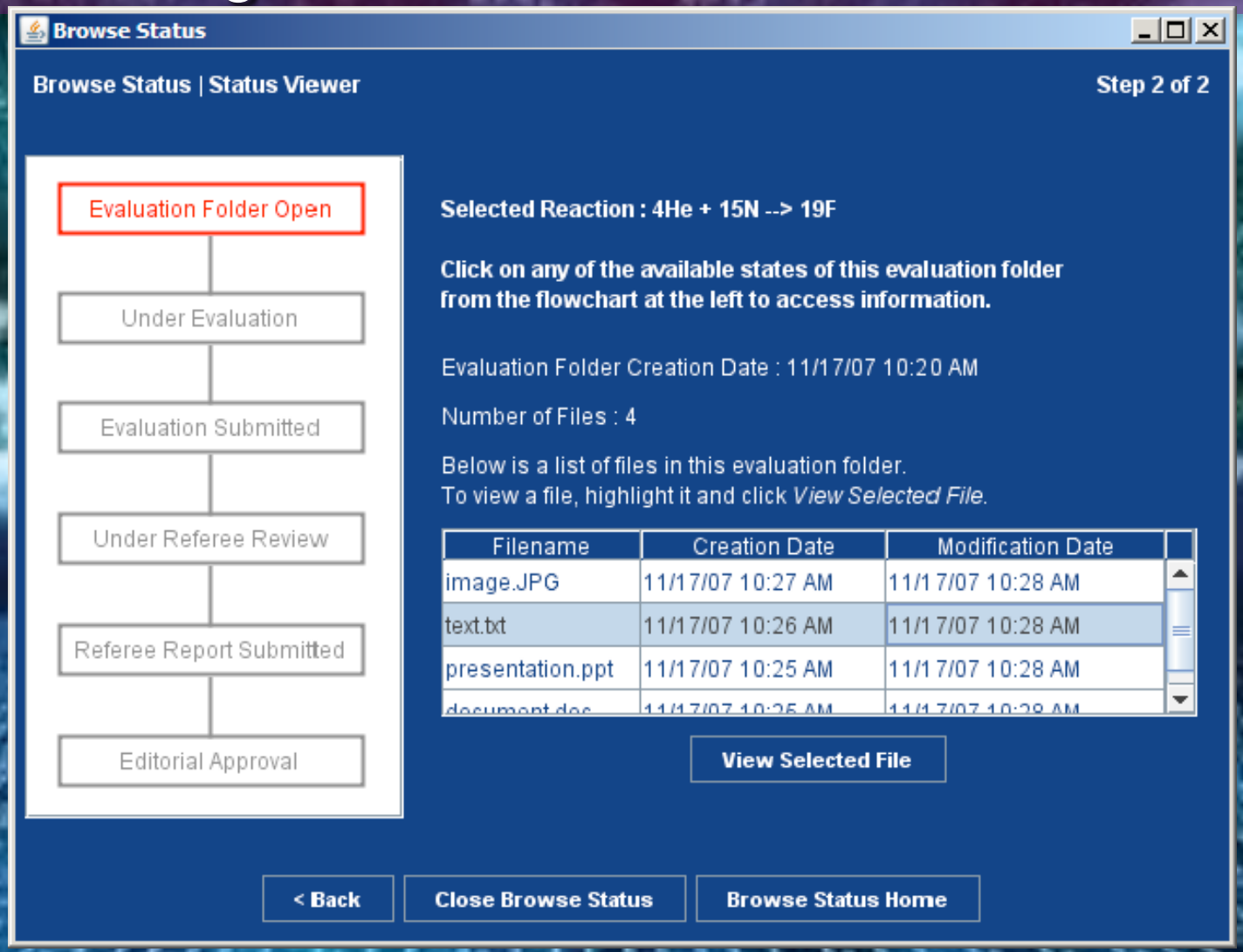
- MANY STEPS FROM STARTING AN EVALUATION TO HAVING IT PUBLISHED
- WOULD BE GREAT TO GIVE TRANSPARENCY & CLARITY TO THIS WORKFLOW

workflow management



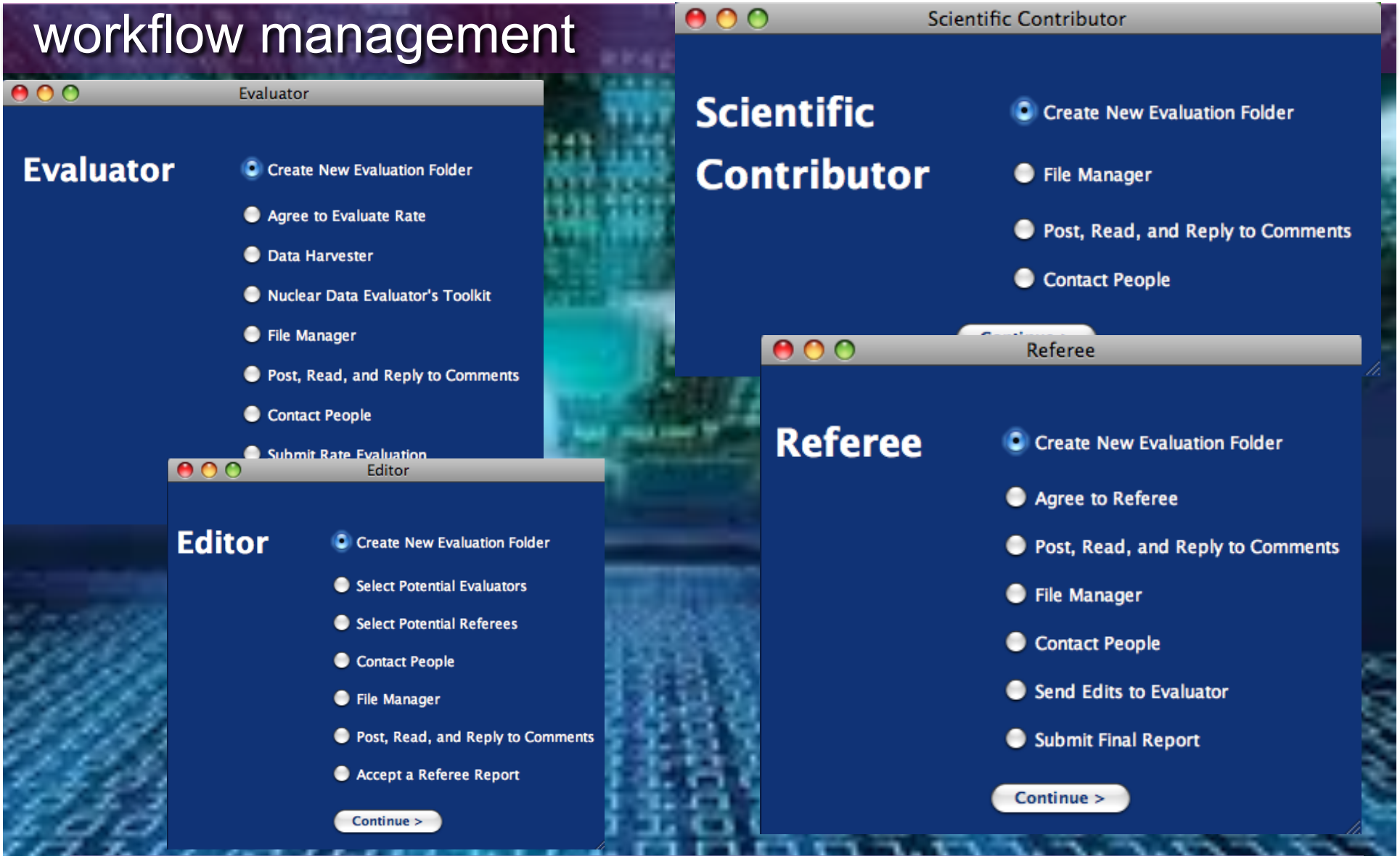
- WE BUILT WORKFLOW TOOLS FOR AN INTERNATIONAL COLLABORATION IN NUCLEAR ASTROPHYSICS

workflow management



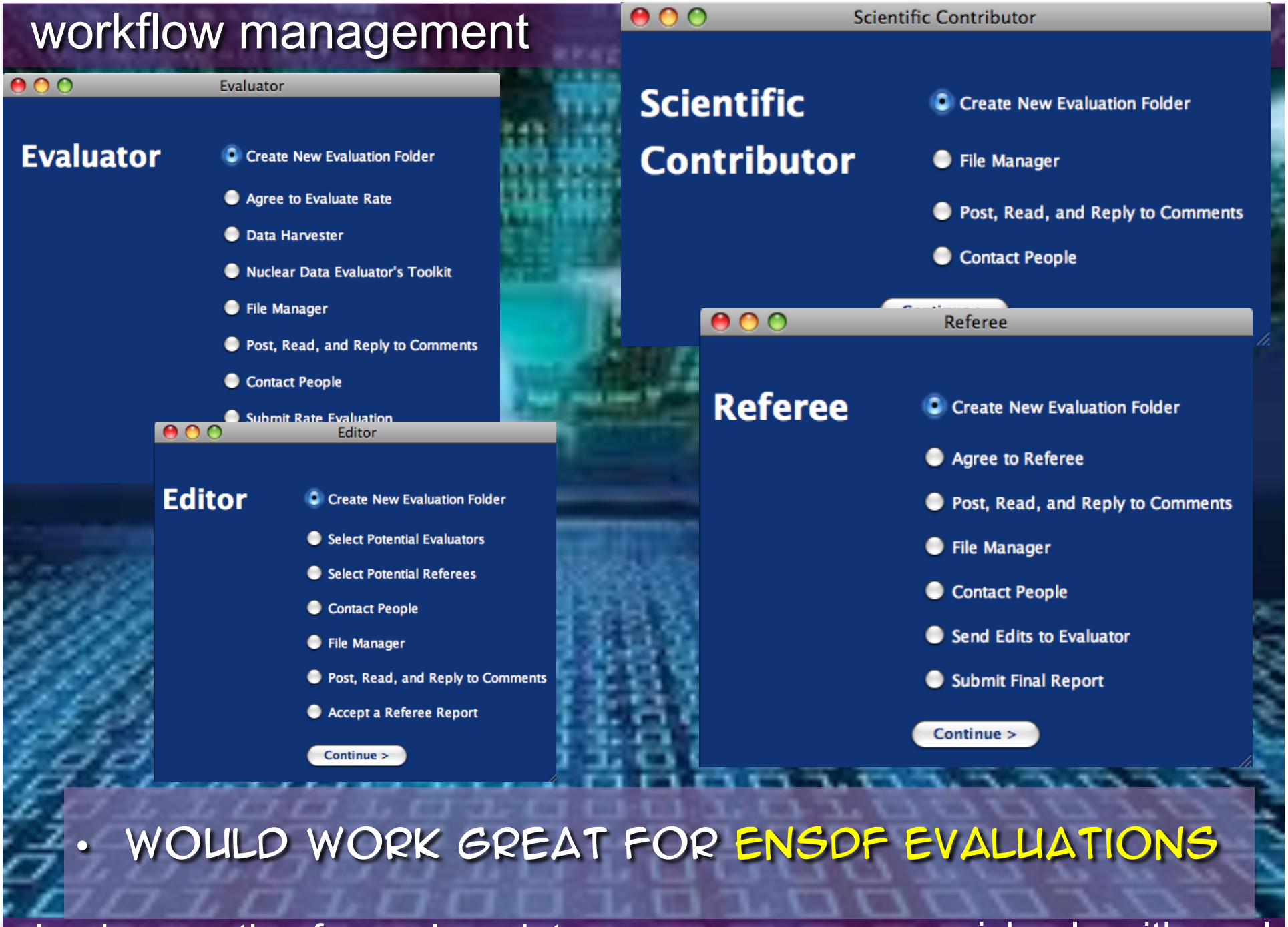
- EASILY UPLOAD YOUR EVALUATION & VISUALLY TRACK ITS PROGRESS FOR REVIEWS, REVISIONS, & ACCEPTANCE

workflow management



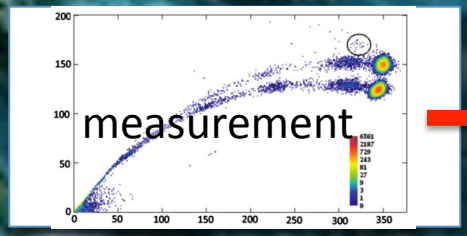
- AUTOMATES & ARCHIVES DIFFERENT TASKS FOR EVALUATORS, REFEREES, EDITORS ...
- SYSTEM IS CUSTOMIZABLE FOR DIFFERENT FIELDS

workflow management



- WOULD WORK GREAT FOR ENSDF EVALUATIONS

virtual pipeline



upload to system

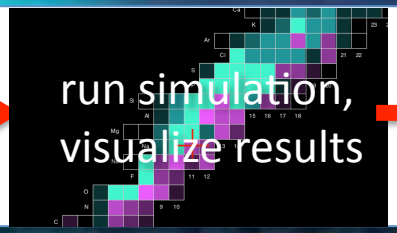
manipulations (gain, normalize, extrapolate …)

process into reaction rate

analytical fit of rate

insert into rate library

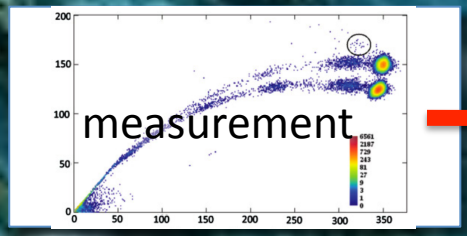
input into simulation



share with colleagues

- INTEGRATION OF DATA COLLECTION, PROCESSING, VISUALIZATION, MANAGEMENT , & END-USER APPLICATIONS …

virtual pipeline



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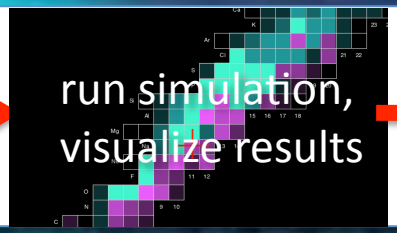


share with colleagues

- CREATED THE FIRST VIRTUAL "PIPELINE" FROM THE NUCLEAR LABORATORY TO ASTROPHYSICS CODES

virtual pipeline

Nuclear Data Manager

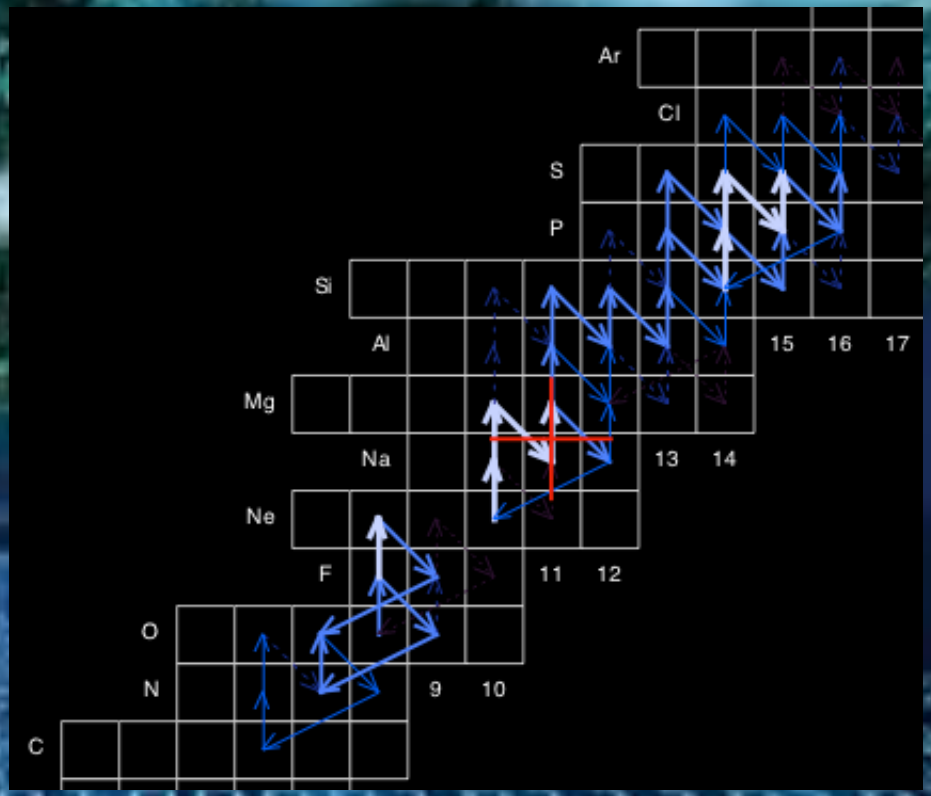
Nuclear Data Manager | Nuclear Data Info

Nuclear Data Information for 20nepg_test

Energy (keV)	Cross Section (b)
3.50000E+02	3.96000E-09
4.40000E+02	1.56000E-08
5.00000E+02	4.07000E-08
5.30000E+02	6.32000E-08
5.80000E+02	9.38000E-08
6.60000E+02	1.58000E-07
7.30000E+02	2.31000E-07
7.60000E+02	3.02000E-07
7.90000E+02	3.30000E-07
8.50000E+02	4.03000E-07
9.50000E+02	5.46000E-07
1.00000E+03	7.96000E-07
1.06000E+03	9.57000E-07
1.07000E+03	9.78000E-07
1.09000E+03	1.05000E-06
1.13000E+03	1.15000E-06
1.17000E+03	1.40000E-06
1.20000E+03	1.40000E-06
1.36000E+03	1.87000E-06
1.43000E+03	2.24000E-06

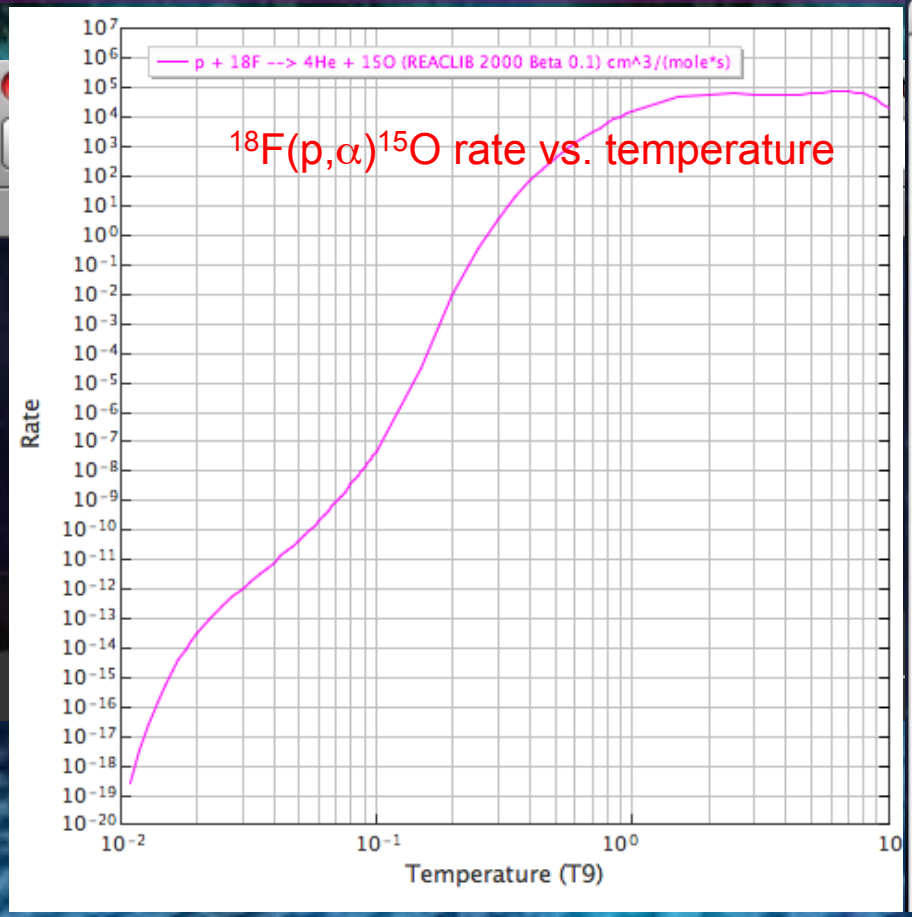
Select Nuclear Data Information for Report:

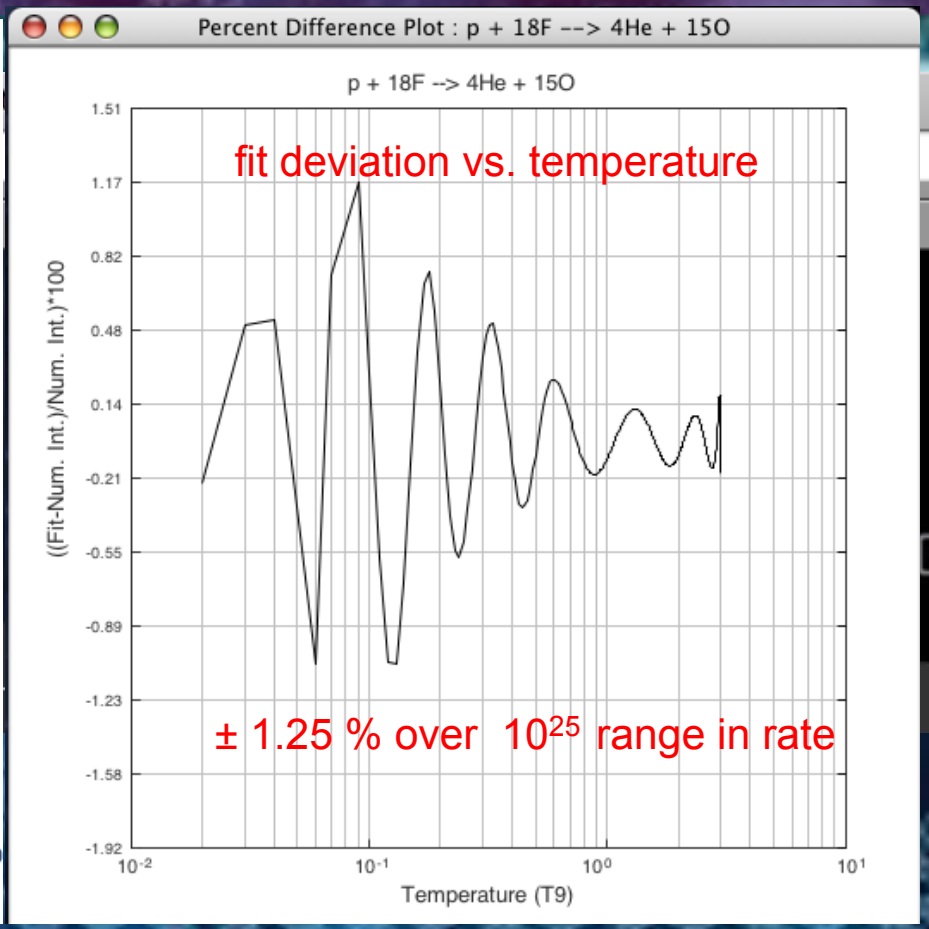
- [x] Data Points
- [ ] Organization Code
- [ ] Scientist Code
- [ ] Notes
- [ ] Reference Citation
- [ ] Creation Date



- SEAMLESSLY MERGING NUCLEAR MANIPULATIONS WITH ASTRO SIMULATIONS, ALL "IN THE CLOUD"

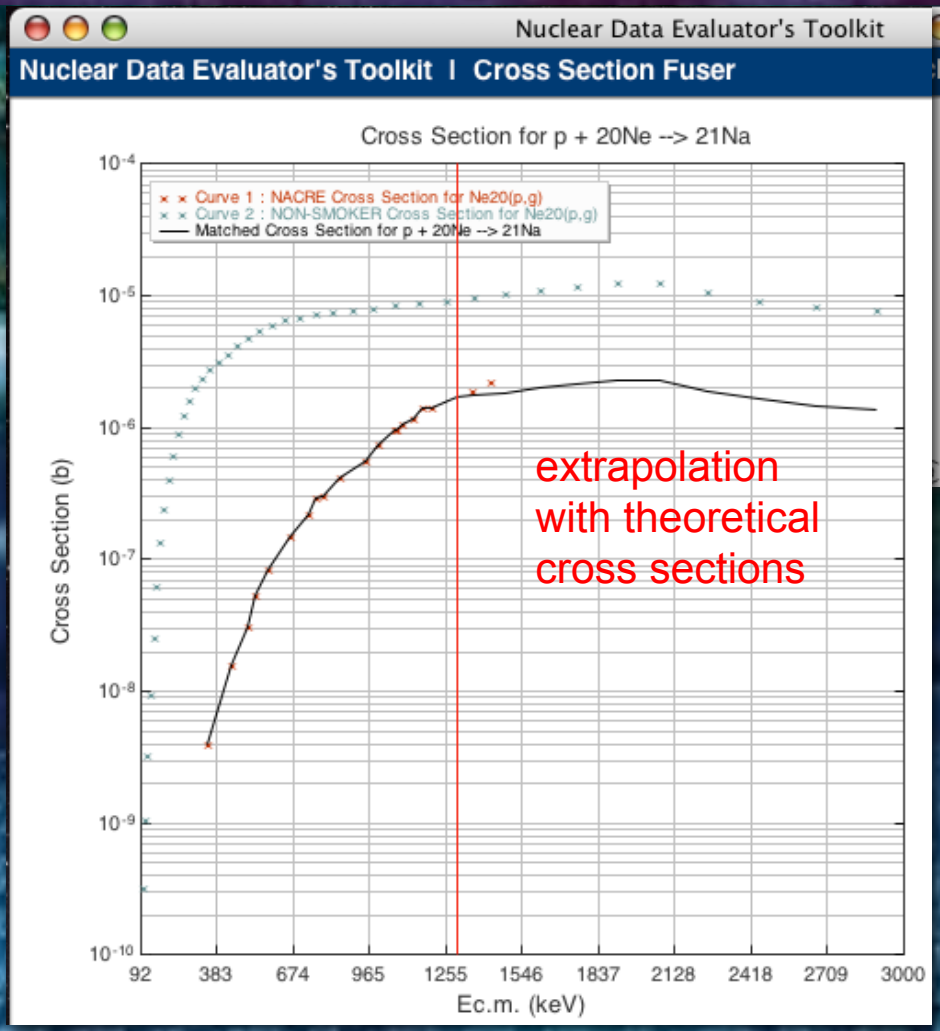
cloud computing

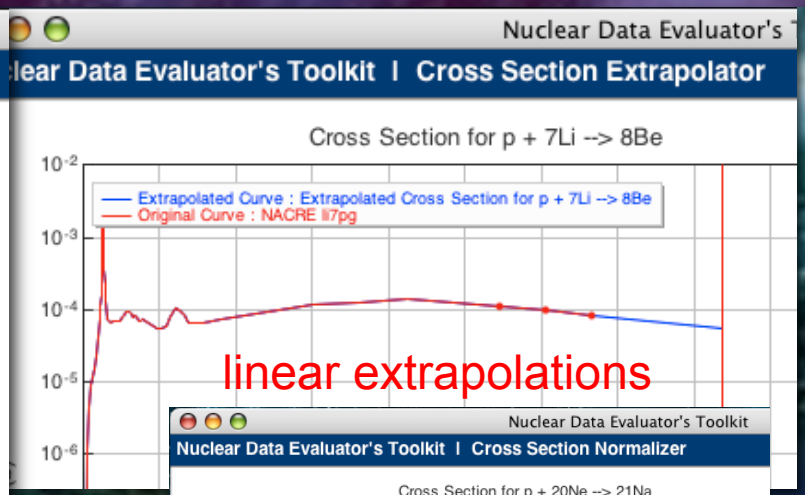


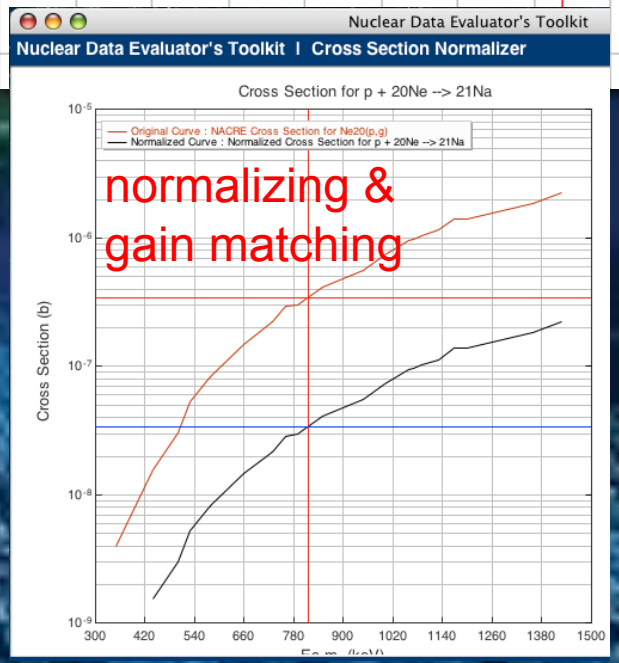


- NUCASTRODATA.ORG HAS BEEN OPERATING "IN THE CLOUDS" WITH "RICH INTERNET APPS" SINCE 2004
- EXAMPLE IS OUR CODE GIVING ANALYTIC FITS TO POINTWISE REACTION RATES TO 2 % PRECISION OVER ~30 ORDERS OF MAGNITUDE

cloud computing







- WE OFFER A NUMBER OF UTILITY CODES IN A "NUCLEAR DATA TOOLKIT"

Computational Methods for Nucleosynthesis and Nuclear Energy Generation

W. Raphael Hix [a,b,c] Friedrich-Karl Thielemann [d,c]

[a] *Joint Institute for Heavy Ion Research, Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, TN 37831-6374*

[b] *Department of Physics and Astronomy, University of Tennessee, Knoxville, TN 37996-1200*

[c] *Physics Division, Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, TN 37831-6373*

[d] *Department für Physik und Astronomie, Universität Basel, CH-4056 Basel, Switzerland*

Abstract

This review concentrates on the two principle methods used to evolve nuclear abundances within astrophysical simulations, evolution via rate equations and via equilibria. Because in general the rate equations in nucleosynthetic applications form an extraordinarily stiff system, implicit methods have proven mandatory, leading to the need to solve moderately sized matrix equations. Efforts to improve the performance of such rate equation methods are focused on efficient solution of these matrix equations, by making best use of the sparseness of these matrices. Recent work to produce hybrid schemes which use local equilibria to reduce the computational cost of the rate equations is also discussed. Such schemes offer significant improvements in the speed of reaction networks and are accurate under circumstances where calculations with complete equilibrium fail.

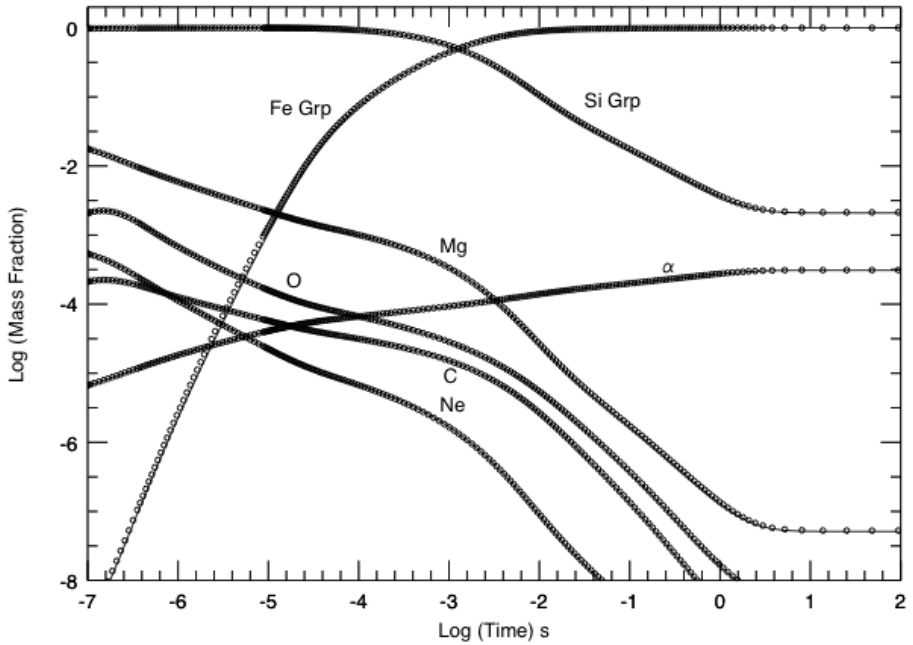


Fig. 4. Evolution of the independent nuclear mass fractions for constant thermodynamic conditions, $T = 5\,\mathrm{GK}$ and $\rho = 10^9\,\mathrm{g\,cm^{-3}}$. The solid lines display the evolution due to a conventional α-network, the circles show the evolution by the QSE-reduced α network.

$$\left.\frac{\partial n_i}{\partial t}\right|_{\rho=const} = \sum_j \mathcal{N}^i_j r_j + \sum_{j,k} \mathcal{N}^i_{j,k} r_{j,k} + \sum_{j,k,l} \mathcal{N}^i_{j,k,l} r_{j,k,l}, \qquad (11)$$

- THE POPULAR NUCLEOSYNTHESIS CODE XNET [HIX & THIELEMANN] IS INTEGRATED INTO OUR "CLOUD"

cloud computing – end user applications

Computational Methods for Nucleosynthesis and Nuclear Energy Generation

W. Raphael Hix [a,b,c] Friedrich-Karl Thielemann [d,c]

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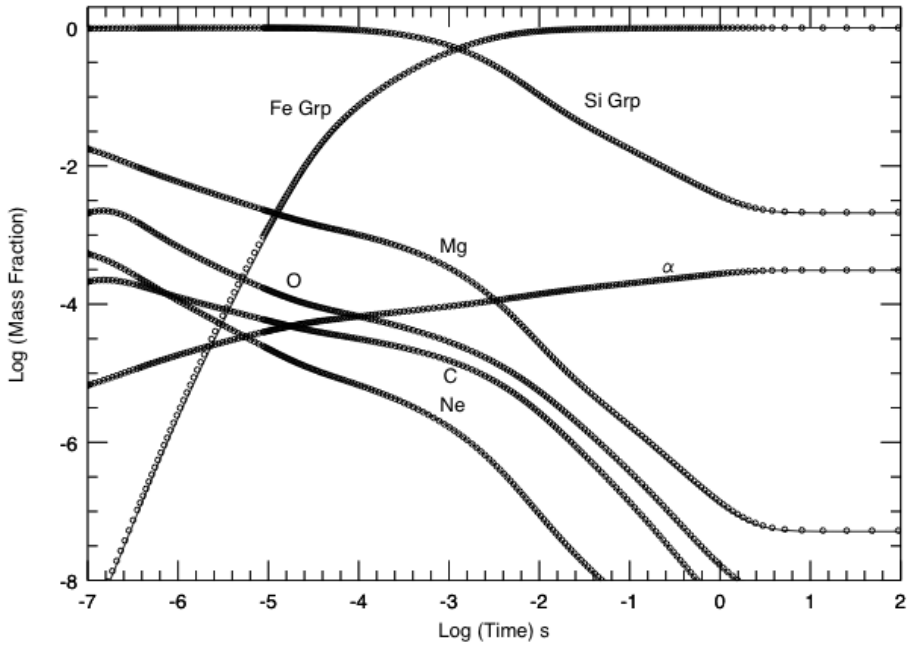

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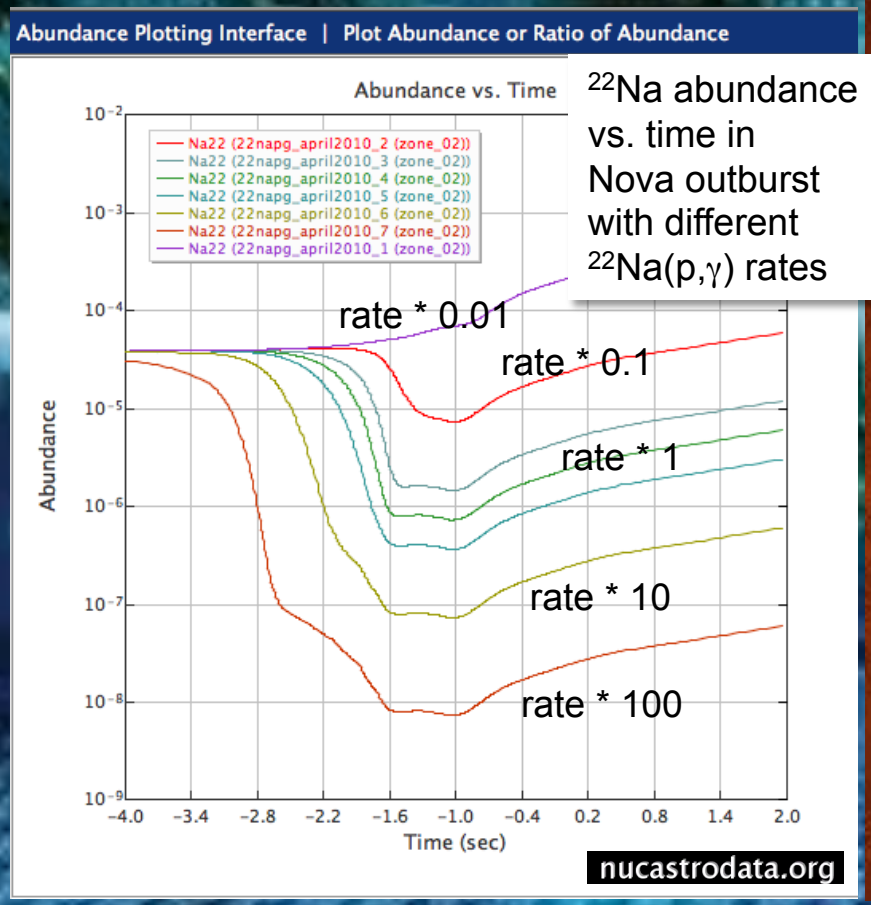
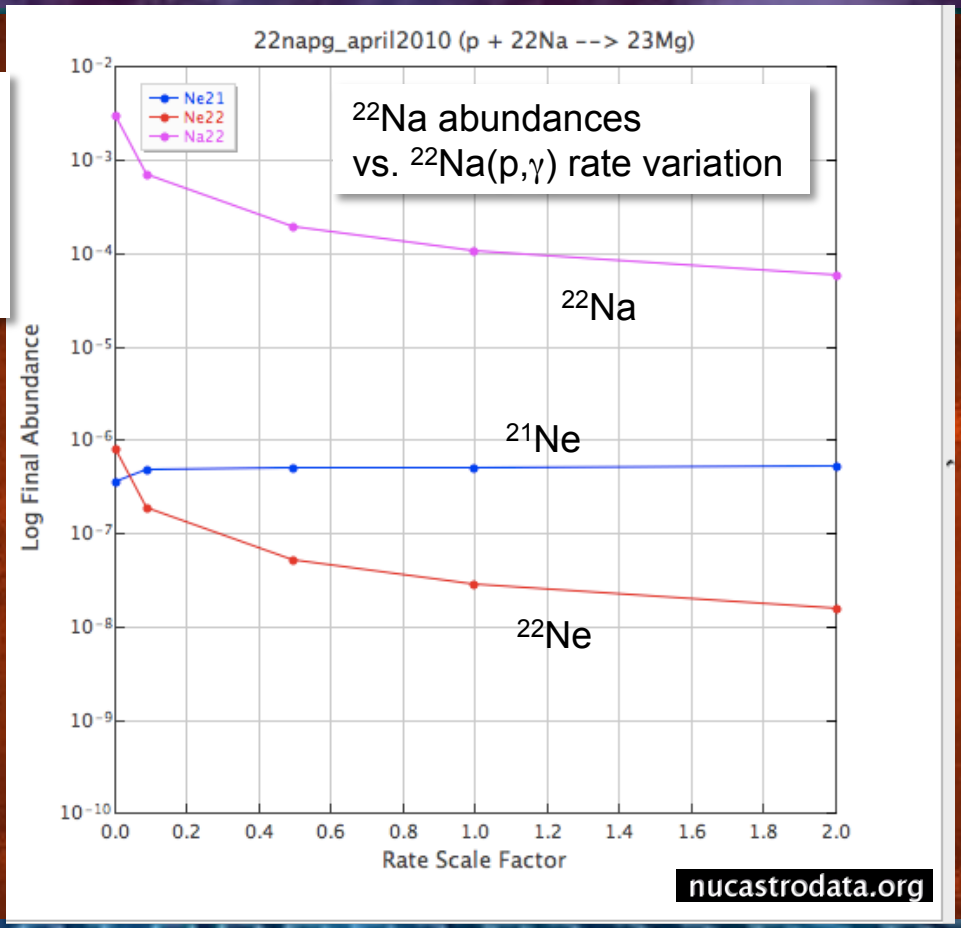
- STREAMLINE EXECUTION OF XNET, STORE RESULTS
- EASY TO USE CUSTOM INPUT NUCLEAR DATA SETS

cloud computing – end user applications



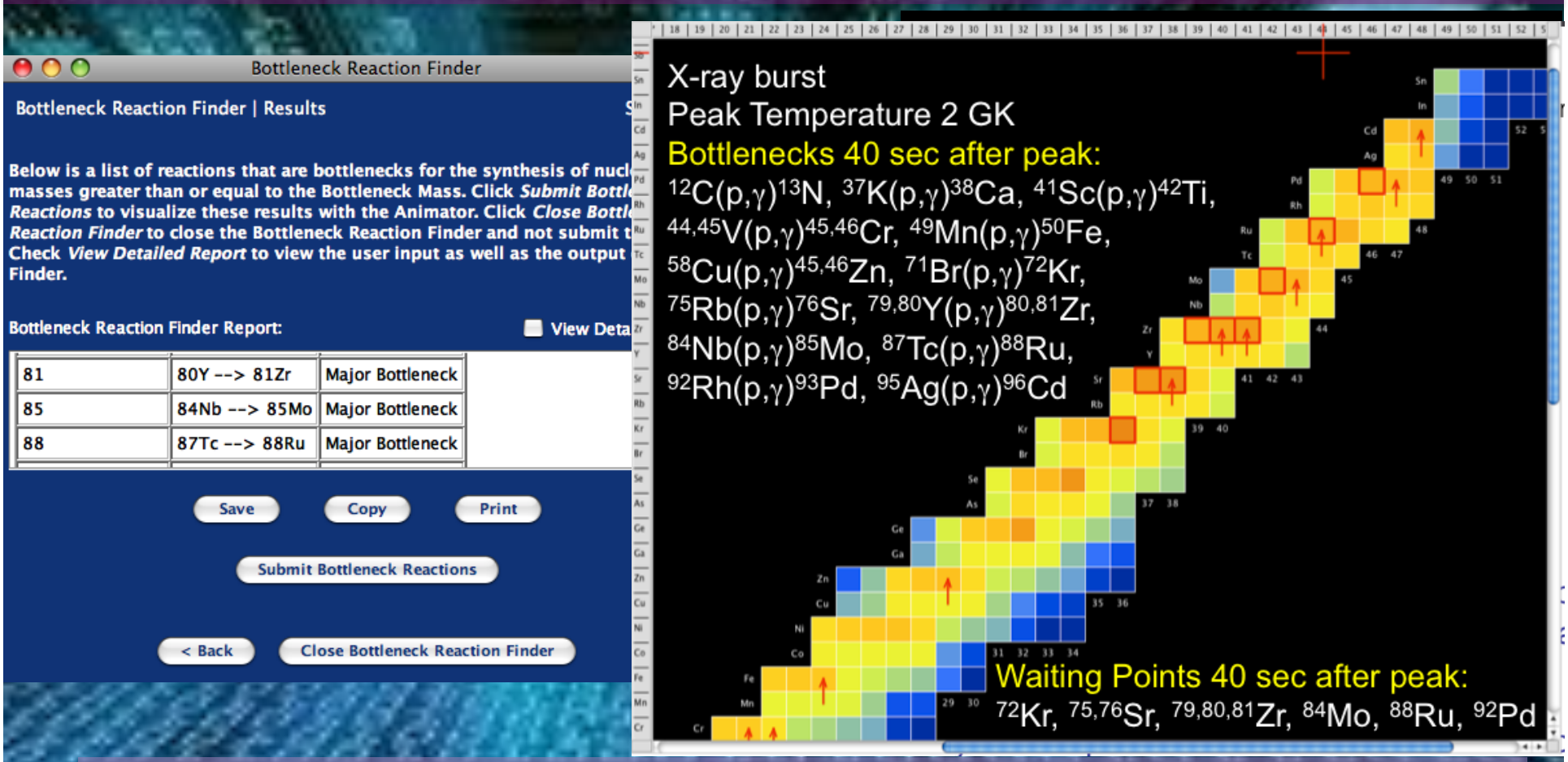
^{22}Na abundance vs. time in Nova outburst with different ^{22}Na(p,γ) rates



^{22}Na abundances vs. ^{22}Na(p,γ) rate variation

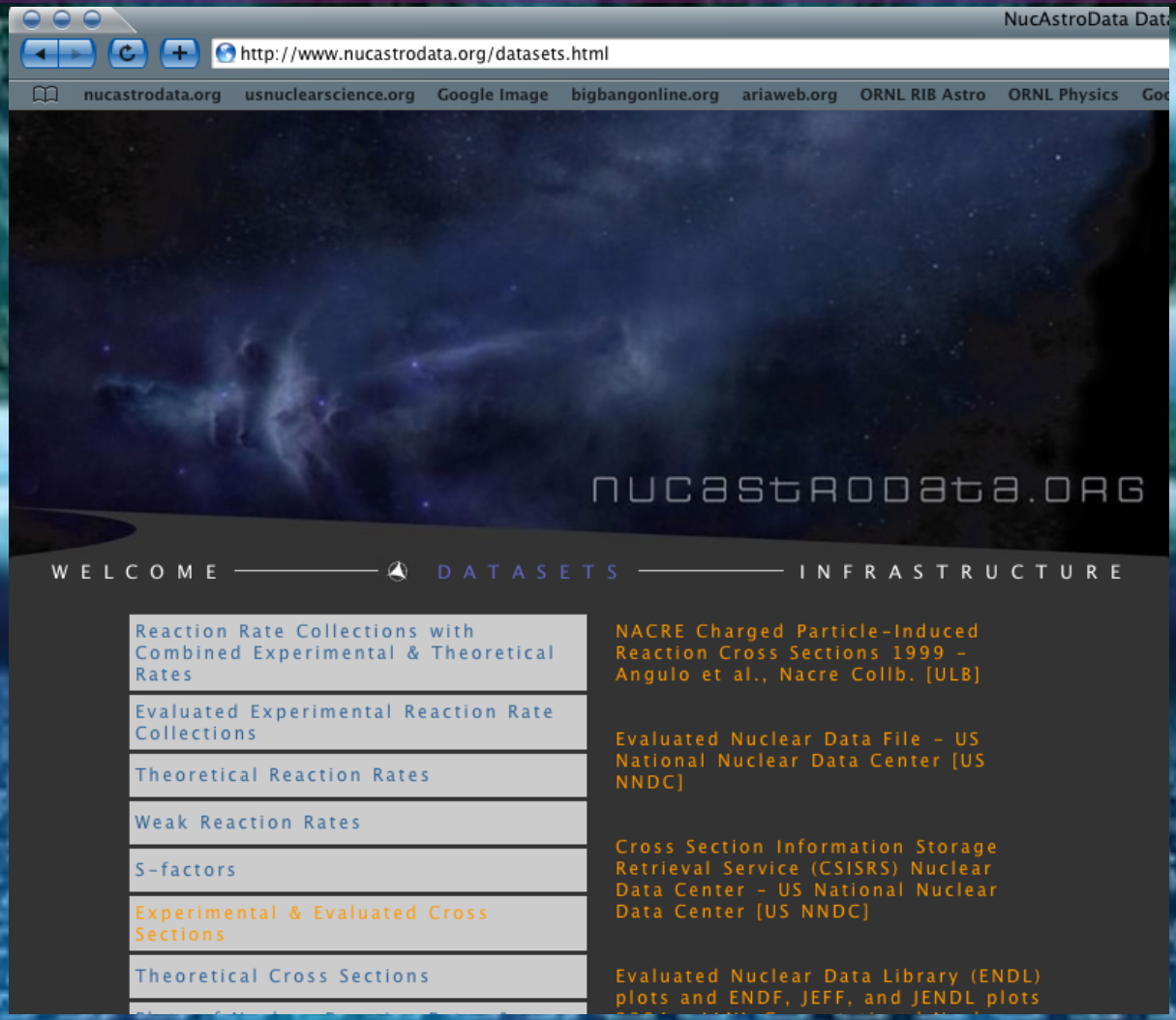
- SENSITIVITY STUDIES: MULTIPLE CODE RUNS TO DETERMINE DEPENDENCE OF OUTPUT ON INPUT
- NOW AUTOMATED WITH 20-FOLD PRODUCTIVITY INCREASE & ELIMINATION OF BOOK KEEPING ERRORS

cloud computing – end user applications



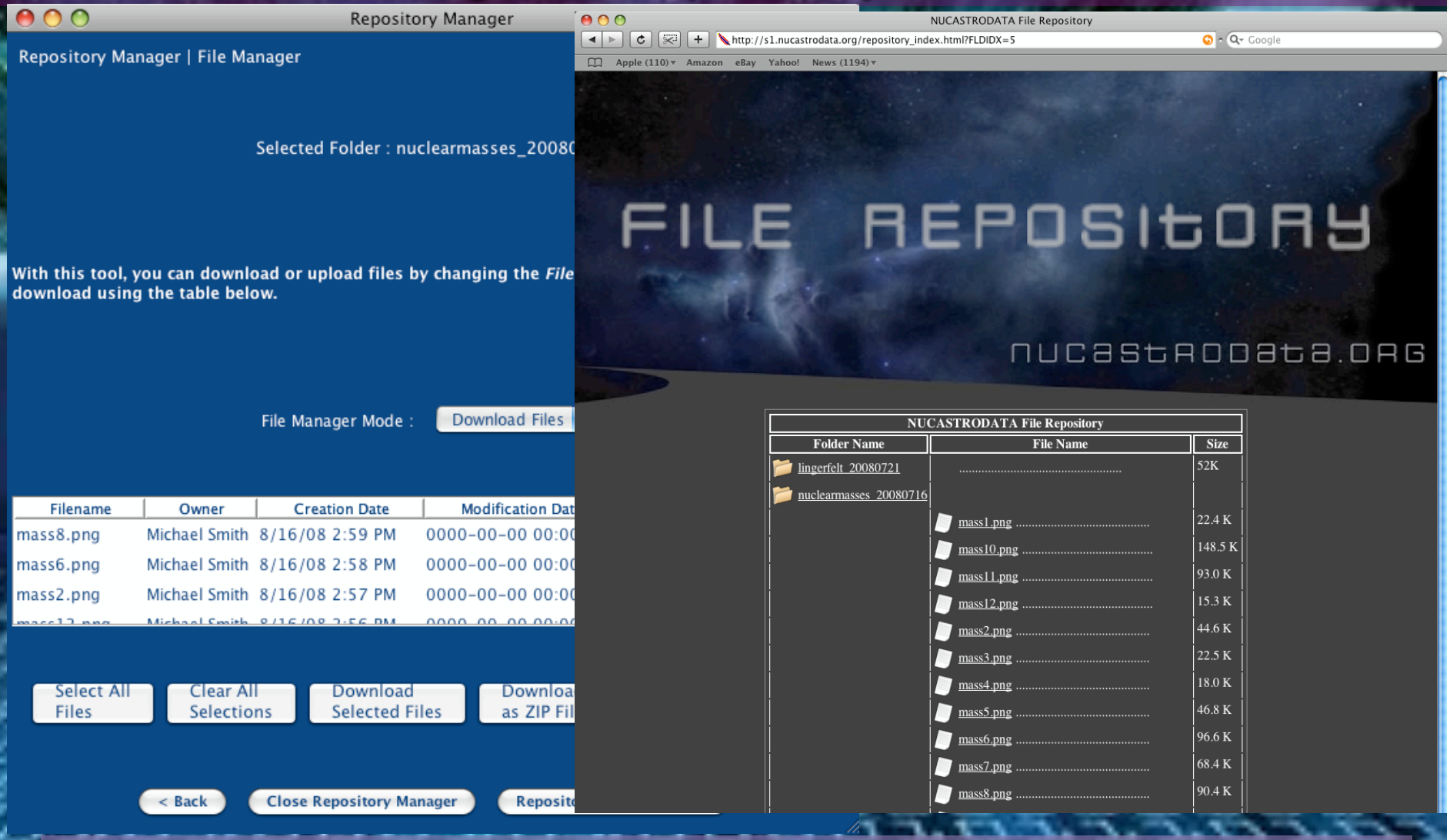
- MOVE BEYOND EXECUTION & VISUALIZATION TO ANALYSIS OF RESULTS
- EXAMPLE: UNIQUE, CUSTOM, AUTOMATIC SEARCHES FOR BOTTLENECK REACTIONS AND WAITING POINT NUCLEI IN NOVAE & X-RAY BURST SIMULATIONS

information sharing - database access



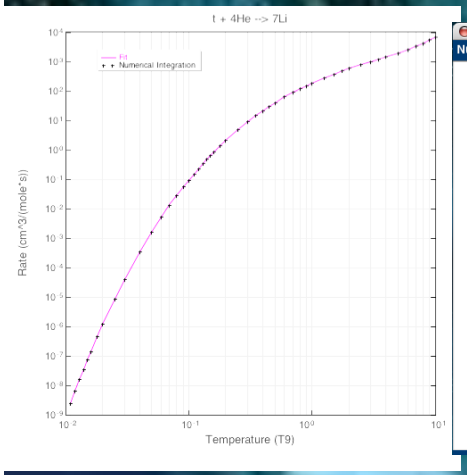
- NUCASTRODATA.ORG LINKS TOGETHER OVER 70 SETS OF NUCLEAR PHYSICS & NUCLEAR ASTRO DATA

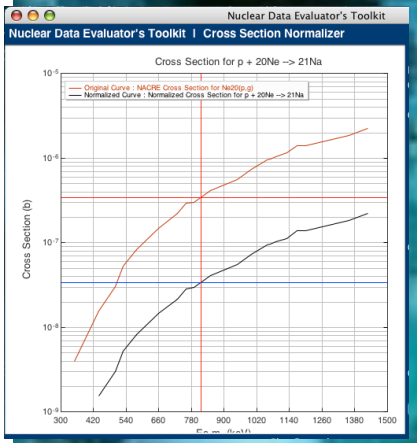
information sharing - file repository

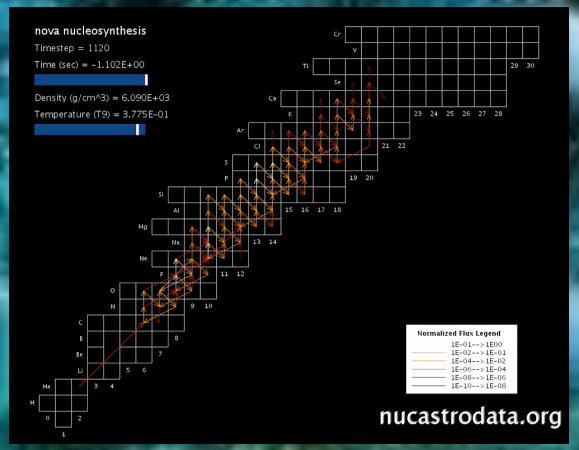


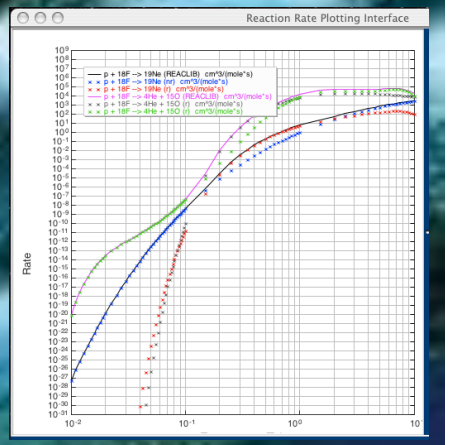
- ALLOWS QUICK SHARING OF FILES IN 32 FORMATS
- UPLOAD QUICKLY, VIEW OVER WEB OR WITHIN SUITE

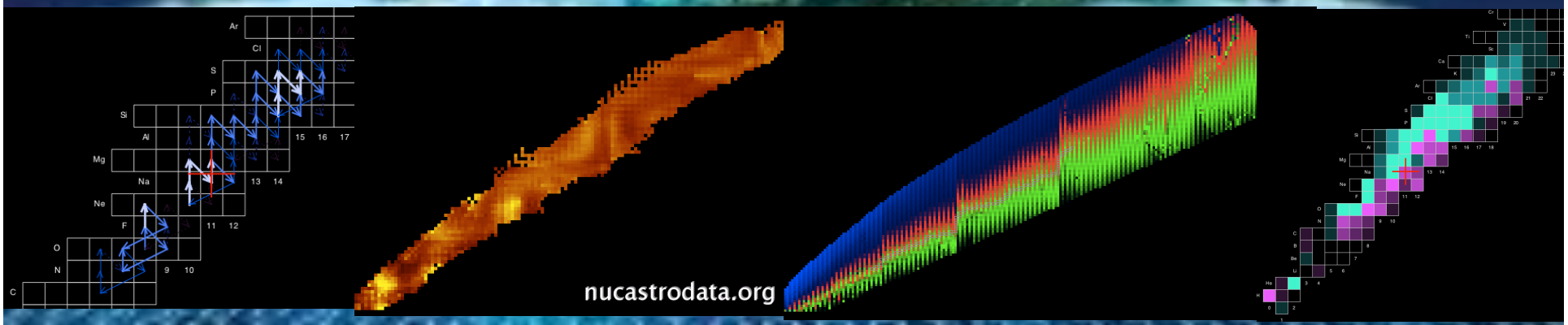
data visualization





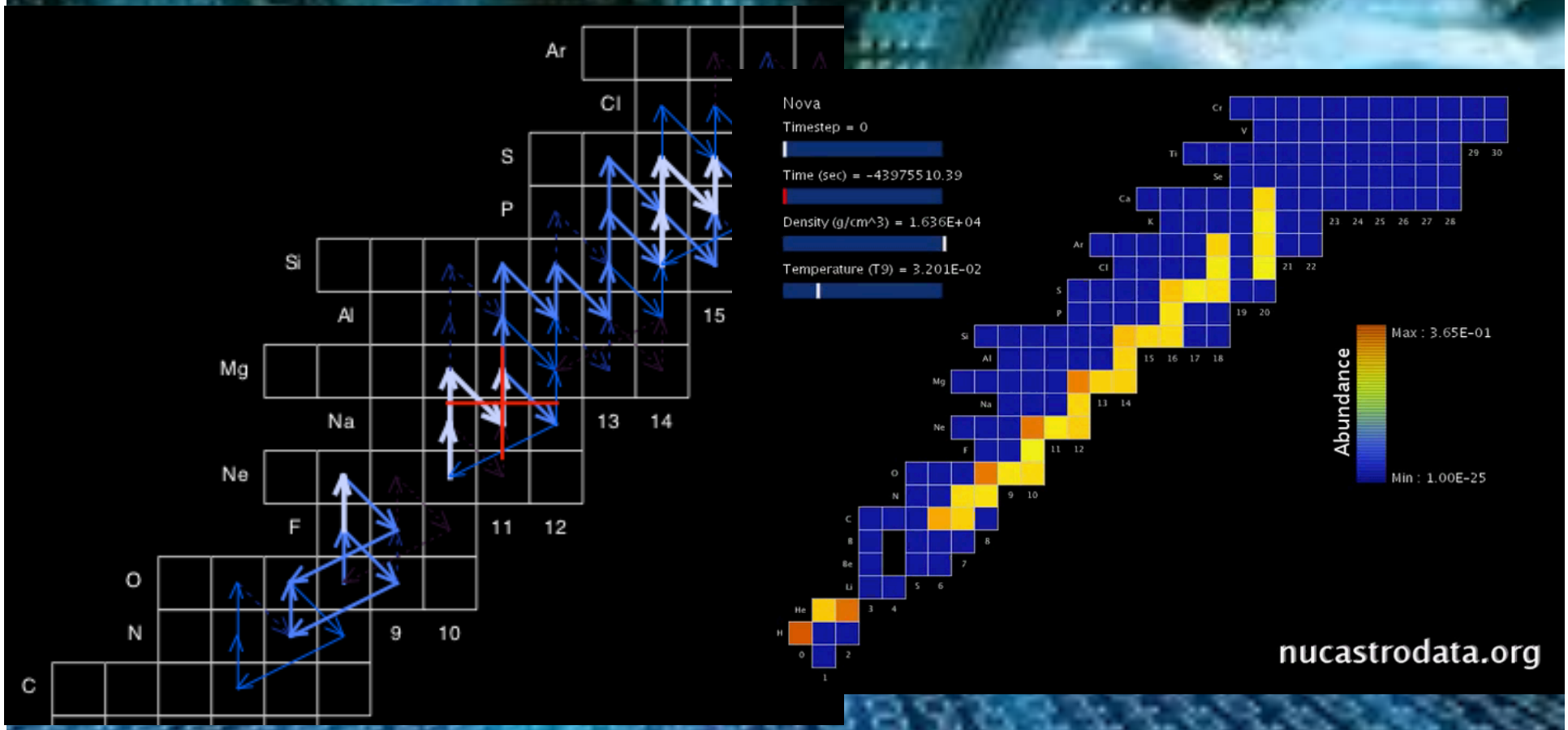






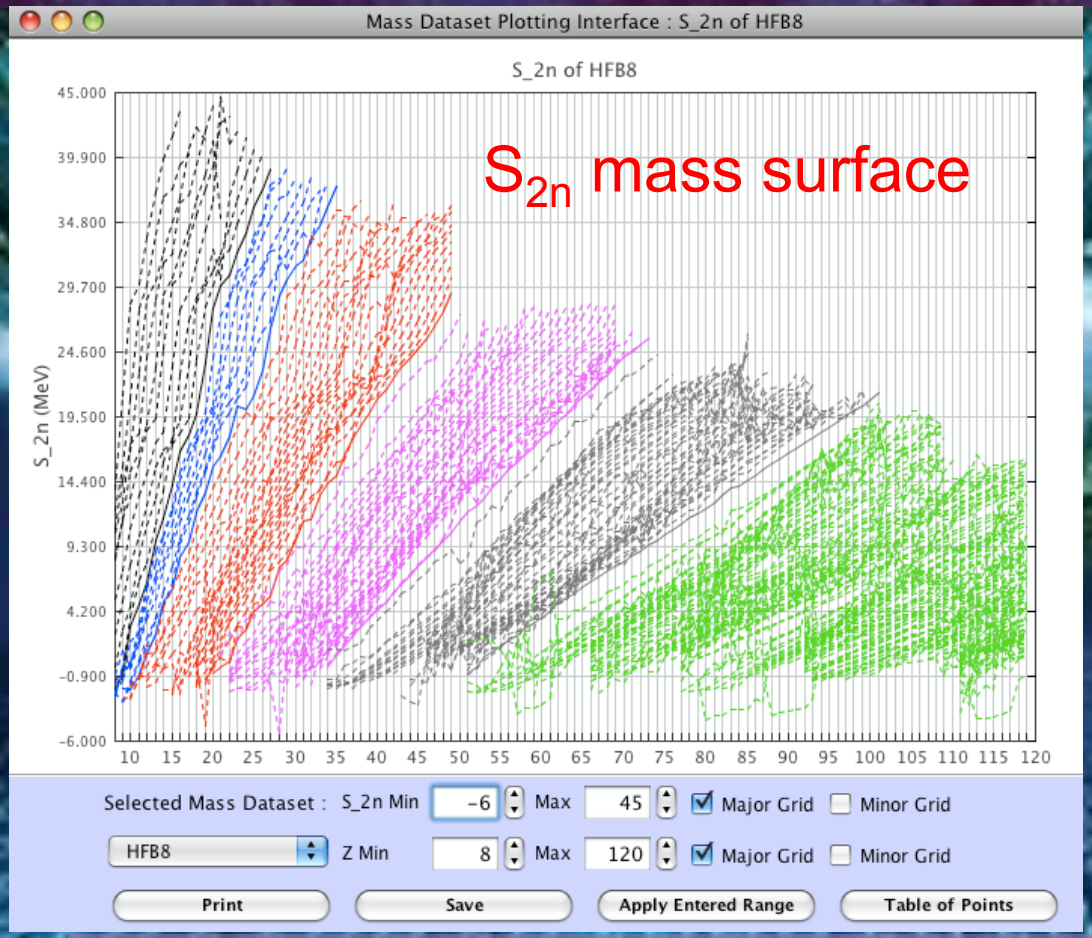
- MOVE BEYOND TEXT TABLES, LINE PLOTS
- DYNAMIC, MULTI-D, ANIMATED, INTERACTIVE PLOTS ARE ESSENTIAL RESEARCH TOOLS
- TREND: USE VIZ TOOLS "IN THE CLOUDS" TO SAVE YOUR DEVELOPMENT TIME

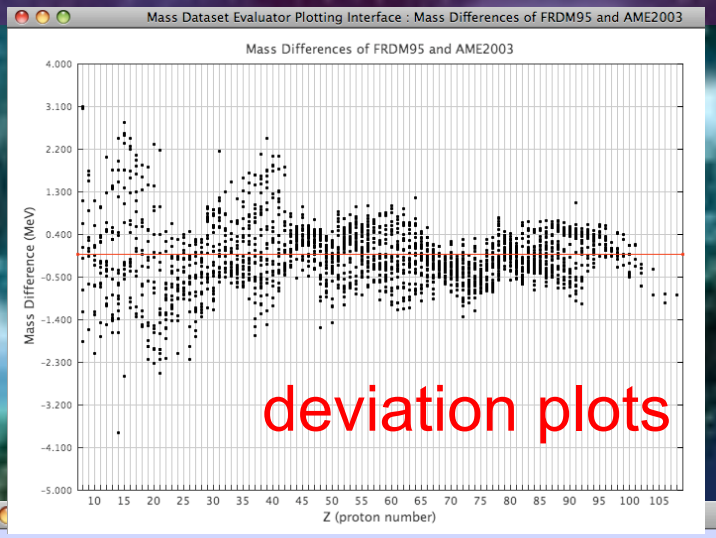
data visualization

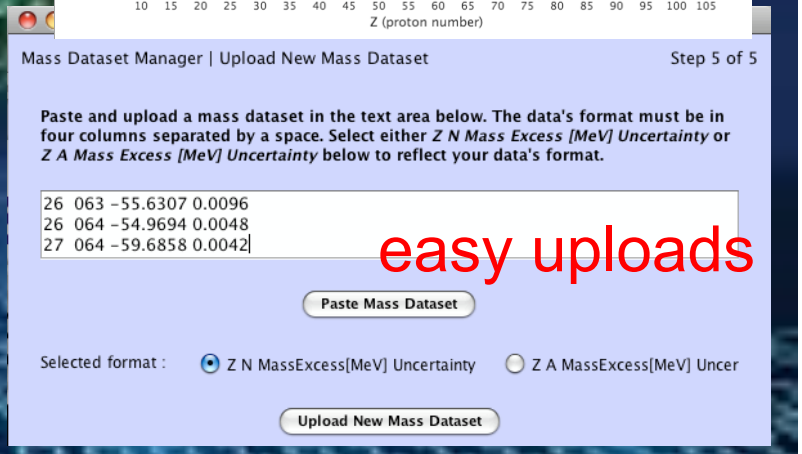


- COMPUTATIONAL INFRASTRUCTURE FOR NUCLEAR ASTROPHYSICS FEATURES 2 - D ANIMATED PLOTS FOR NUCLEAR BURN CALCULATIONS
  - REACTION FLOW VS. TIME
  - ABUNDANCE VS. TIME

data visualization

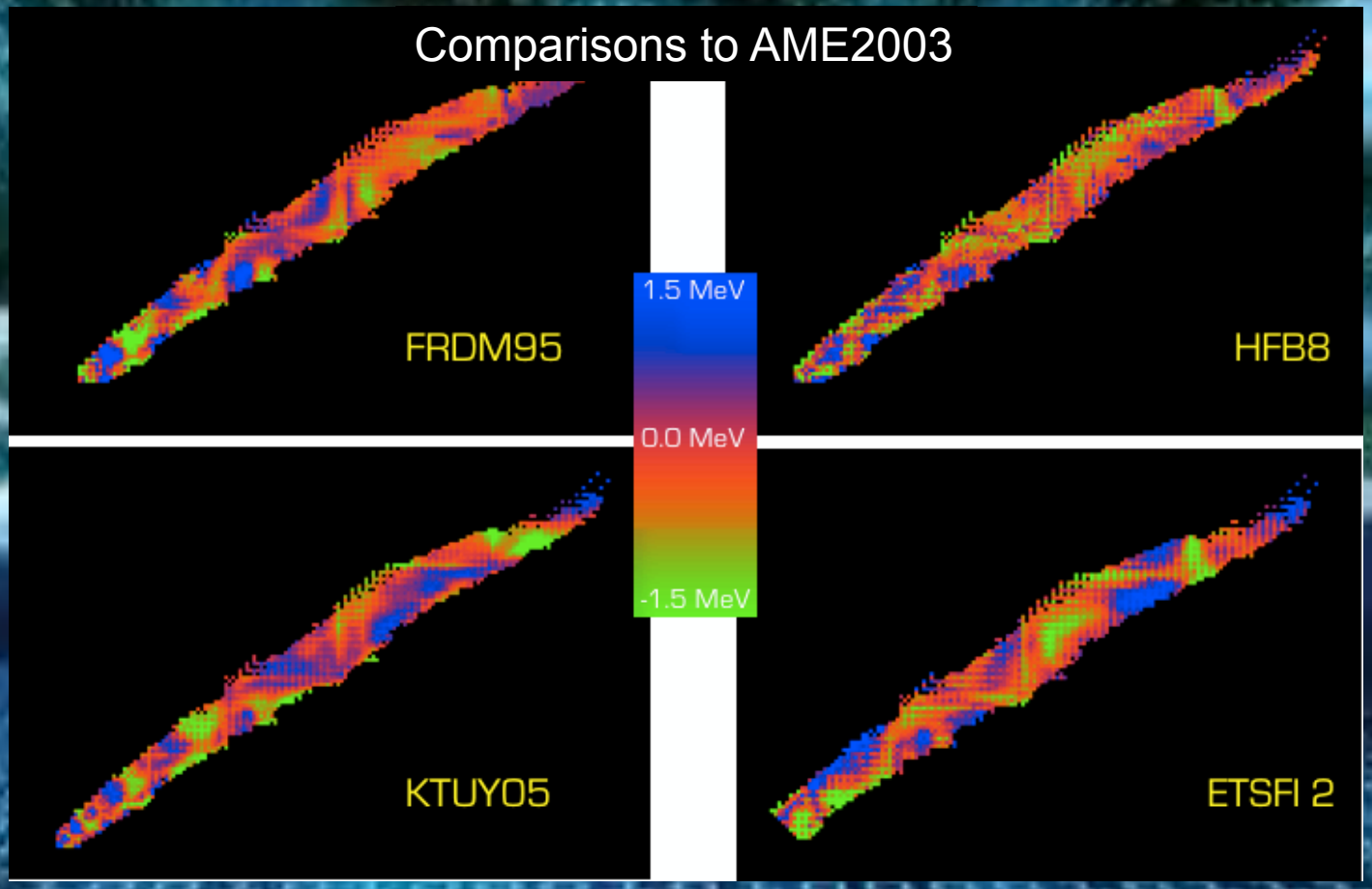






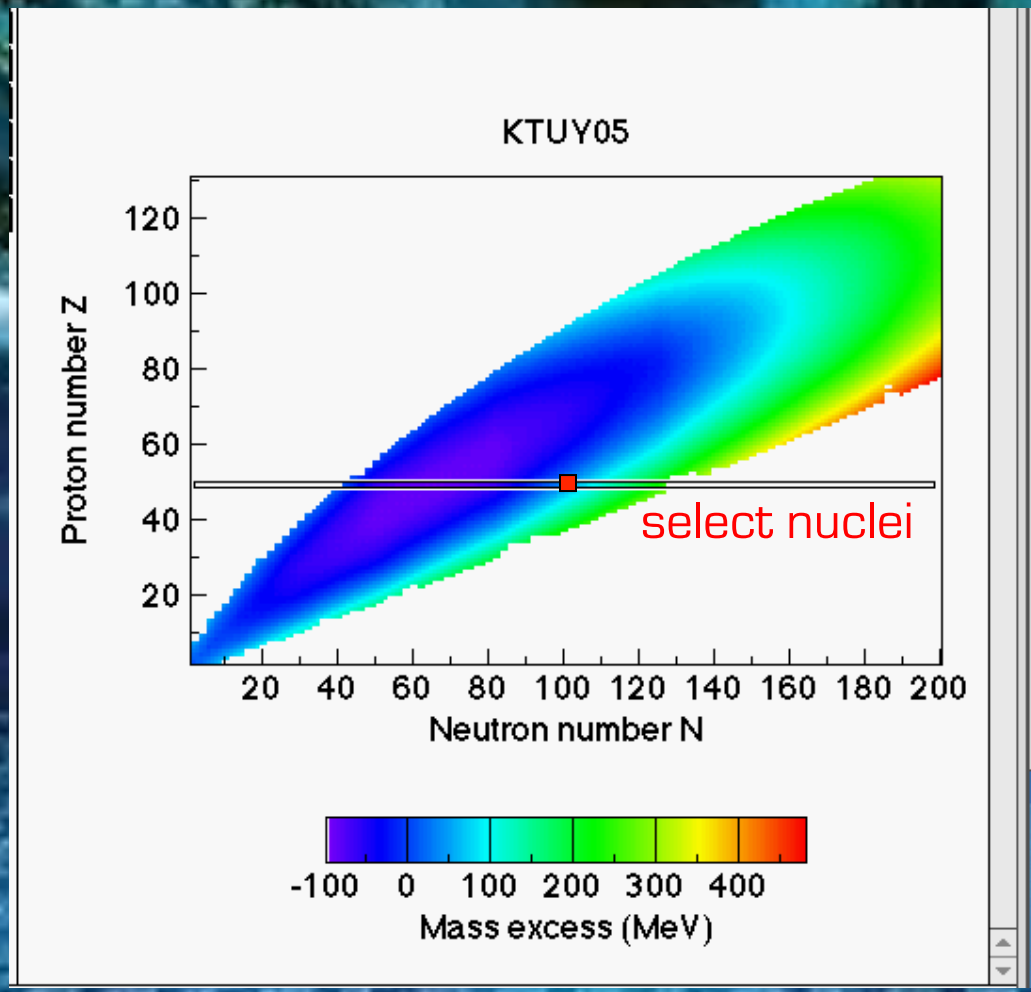
- NUCLEARMASSES.ORG ADVANCES MASS DATASETS FROM TEXT TABLES TO DYNAMIC 1D & 2D PLOTS
- INTEGRATES UPLOADING OF DATA SETS WITH PLOTTING AND ANALYSIS TOOLS

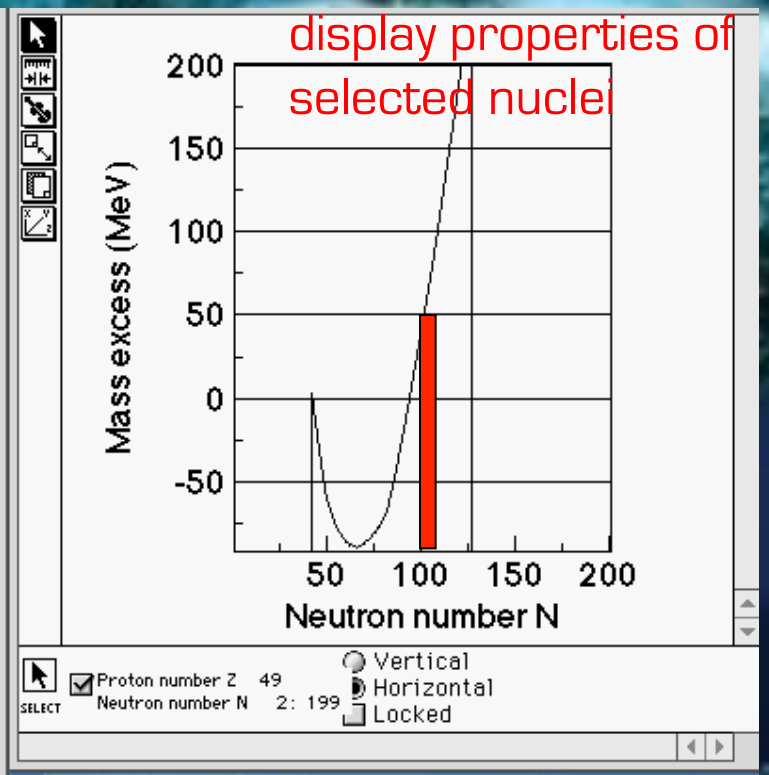
data visualization



- NUCLEARMASSES.ORG ADVANCES MASS DATASETS FROM TEXT TABLES TO DYNAMIC 1D & 2D PLOTS
- QUICK COMPARISONS OF DATASETS (THEORY, EXPERIMENTAL, EVALUATED) OVER MANY PARAMETERS

data visualization





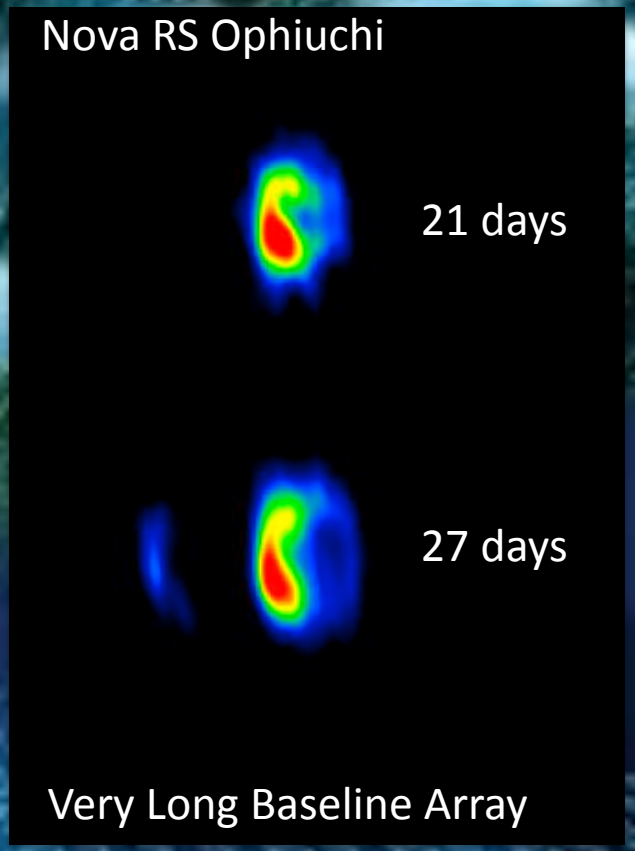
H. Koura, JAEA

- FUTURE FEATURE AT NUCLEARMASSES.ORG: INTERACTIVE MASS PLOTS

information sharing

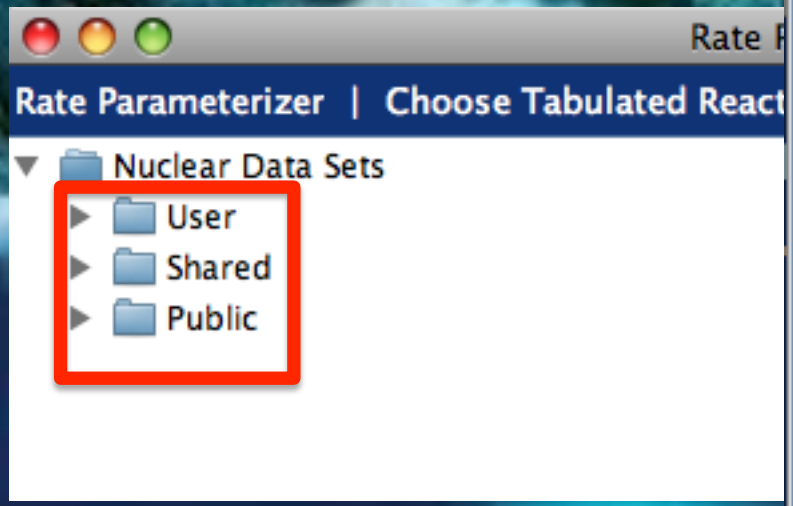
```
 real control parameters=

acrate= 1.00D+16     alpha = 0.00D+00     alte  = 0.00D+00     dccmax= 5.50D+05     dmstar= 1.00D-22
dumax = 1.00D-01     dwmax = 1.00D-02     dzmax = 1.00D-02     eqtol = 1.00D-04     fudge = 1.00D+00
rmstar= 2.68D+33     timadv= 1.00D+00     tsincr= 1.40D+00     uslop = 1.00D+07     utol  = 1.00D-04
visc  = 2.00D+00     wtol  = 1.00D-04     ztol  = 1.00D-04    balpha= 0.00D+00    new   = 1.00D+00
dotm  = 1.59D-10     ratmas= 1.19D+00     baccr = 0.00D+00    bkappa= 1.00D+00    accdel= 0.00D+00
fracma= 0.10D+01     soslim = 1.00D+12     pram   = 0.00D+00     radprs = 3.71D+04



 integer control parameters

icomp =     69    icpumi=
nrezon=     95    jconv =
nzone =     95    mdbug1=10



 logical control parameters

 xaccre= T    xdiff = F    xdtime= F    xechek= F    xevolv= T    xrezon= F    xdown= F    xtape = T


 bcore= 0.00D+00  pram= 0.00D+00  radprs= 3.71D+04  y2(i)* 1.00D+00  radbnd* 1.00D+00  n2time=    1

1    i   qface          qlface       r           b           t           rho          p     kappa        mass
     1  9.99993D-01  7.44902D-06  4.34249D-01  0.00000D+00  7.04139D+00  8.95404D+00  2.66129D+01 -1.86319D+01  4.28681D+32
     2  8.40330D-01  1.59670D-01  7.68533D+00 -6.66449D-08  7.04139D+00  8.79292D+00  2.63946D+01 -1.81580D+01  3.60236D+32
     3  7.06160D-01  2.93840D-01  7.80064D+00 -1.44735D-07  7.04139D+00  8.65525D+00  2.62082D+01 -1.77492D+01  3.02719D+32
     4  5.93411D-01  4.06589D-01  7.87169D+00 -1.21636D-02  7.04759D+00  8.52965D+00  2.60381D+01 -1.73441D+01  2.54386D+32
     5  4.98665D-01  5.01335D-01  7.92399D+00 -2.23567D-02  7.05585D+00  8.41210D+00  2.58789D+01 -1.69504D+01  2.13770D+32
     6  4.19046D-01  5.80954D-01  7.96571D+00 -2.72306D-02  7.06370D+00  8.30064D+00  2.57279D+01 -1.65740D+01  1.79639D+32
     7  3.52140D-01  6.47860D-01  8.00054D+00 -2.03553D-02  7.06855D+00  8.19413D+00  2.55837D+01 -1.62236D+01  1.50957D+32
     8  2.95916D-01  7.04084D-01  8.03046D+00  3.37144D-02  7.06142D+00  8.09184D+00  2.54451D+01 -1.59359D+01  1.26854D+32
     9  2.48669D-01  7.51331D-01  8.05669D+00  9.79356D-02  7.04139D+00  7.99352D+00  2.53116D+01 -1.57100D+01  1.06600D+32
```

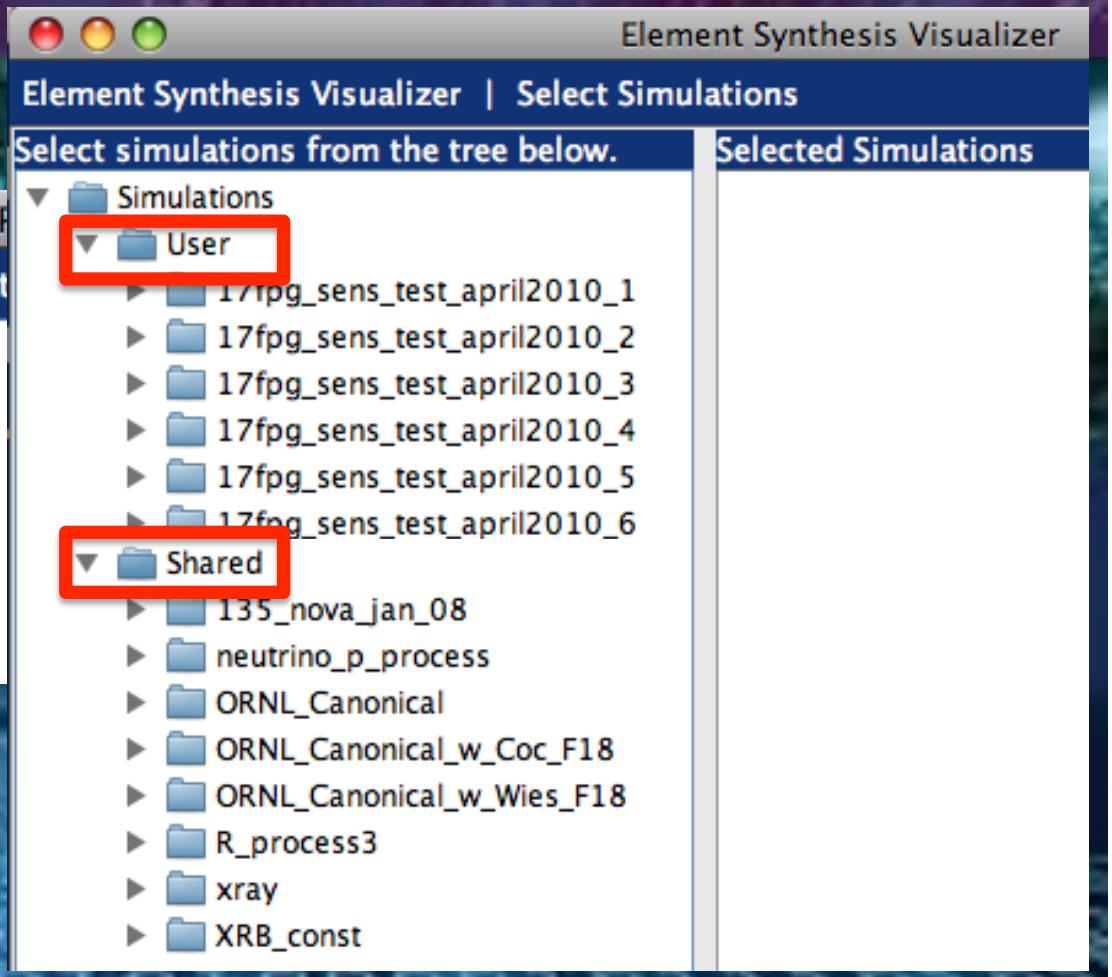
Nova RS Ophiuchi simulation
Hydrodynamics 1D + thermonuclear burn
Sumner Starrfield [Arizona State Univ.],
Tomomi Sunayama [Yale],
Raph Hix & MSS [ORNL]



- MANY DATA SETS TOO LARGE TO EMAIL, FTP OFTEN CUMBERSOME
- WE BUILT MECHANISMS TO SHARE DATA SETS & DOCUMENTS EASILY WITH COLLEAGUES
- SUBSCRIBER MODEL: REGISTER FOR FREE DISK SPACE

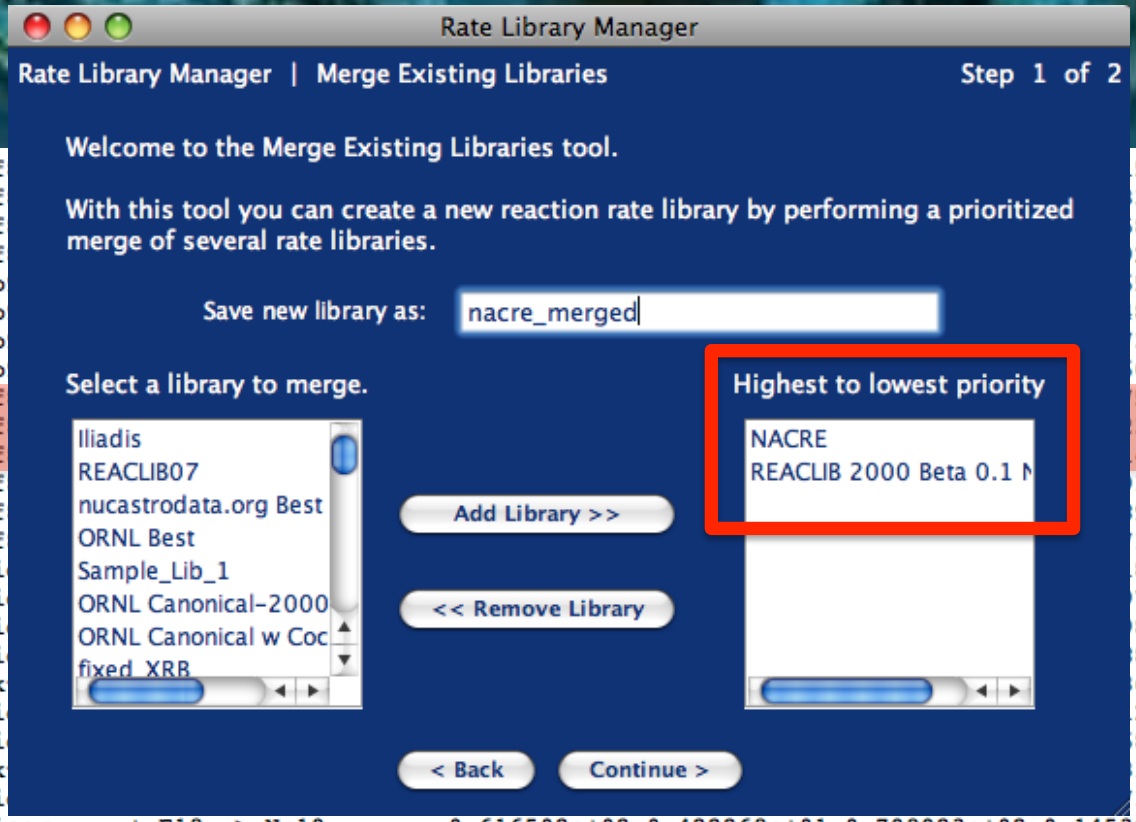
information sharing





- OUR SYSTEM FEATURES USER [PRIVATE], SHARED, AND PUBLIC DATA SPACES
- EASY TO SHARE LARGE CUMBERSOME DATASETS AND USE WITH ALL OUR DATA/VIZ/SIM TOOLS
- FORMS AN ONLINE COMMUNITY

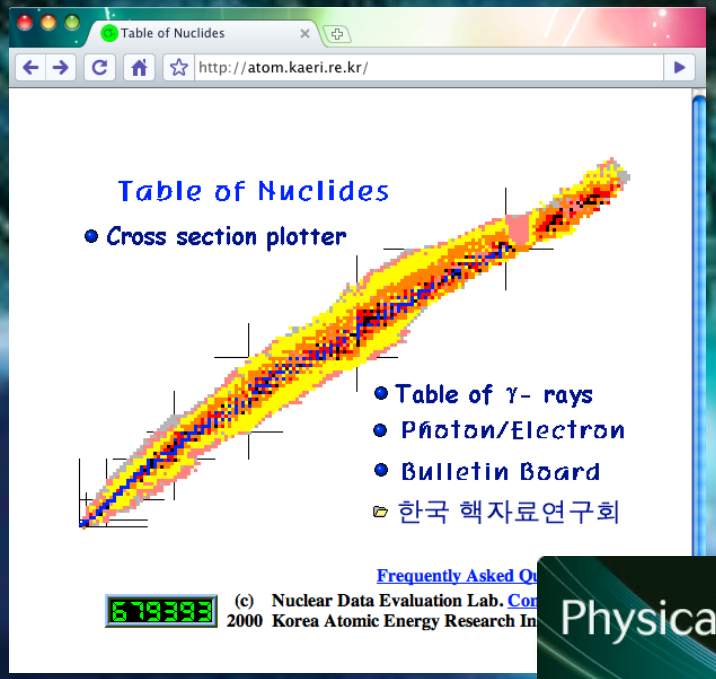
information sharing – dataset merging

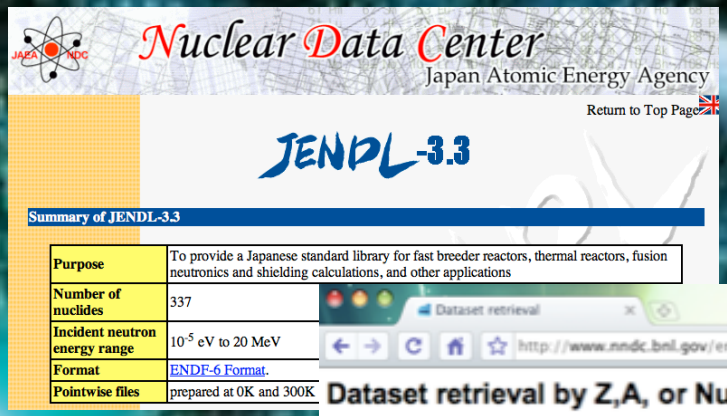


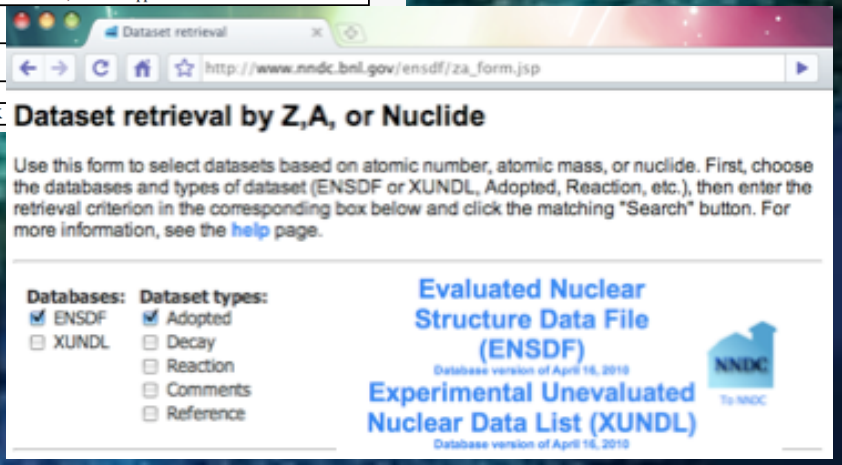
REACLIB
Rauscher, Thielemann et al.
> 60,000 rates

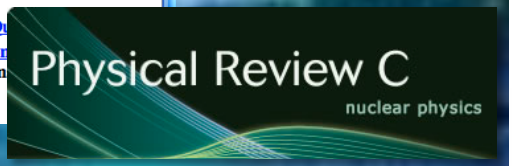
- INTEGRATED TOOLS FOR DATA MODIFICATION / MERGING / MANAGEMENT
  - SPEEDS WORK
  - IMPROVES ACCURACY !!
  - SIMPLIFIES REPETITIVE TASKS

data harvesting



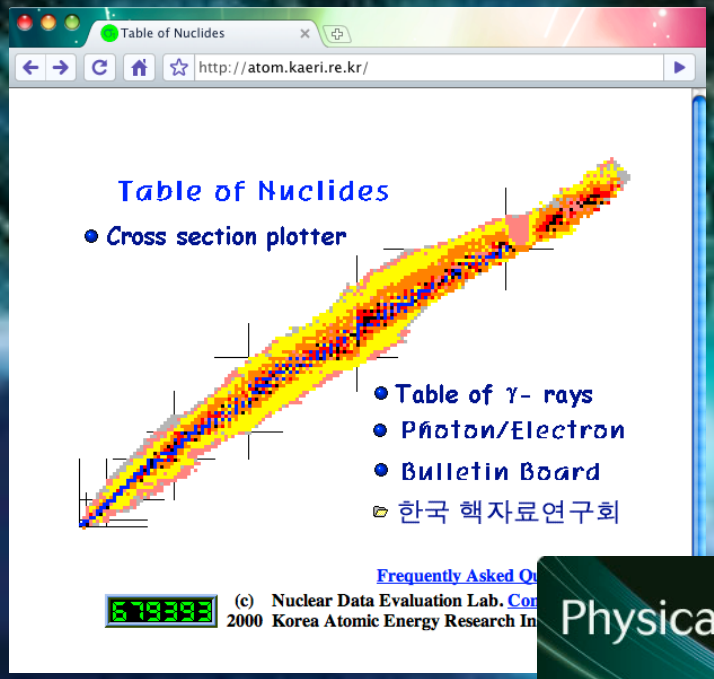


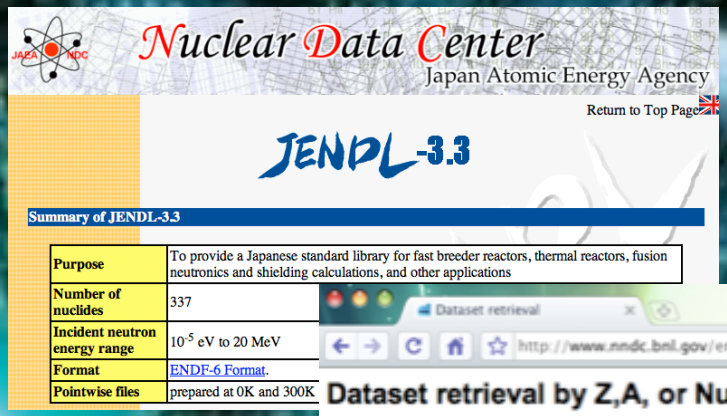


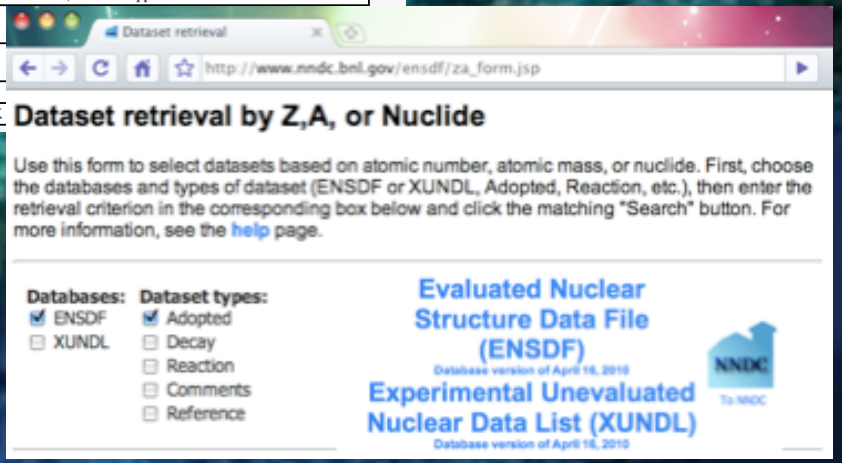


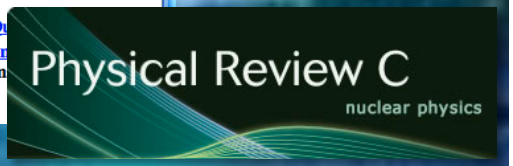
- MANY OF US VISIT THE SAME SITES EVERY TIME WE LAUNCH AN EVALUATION OR INVESTIGATION

data harvesting



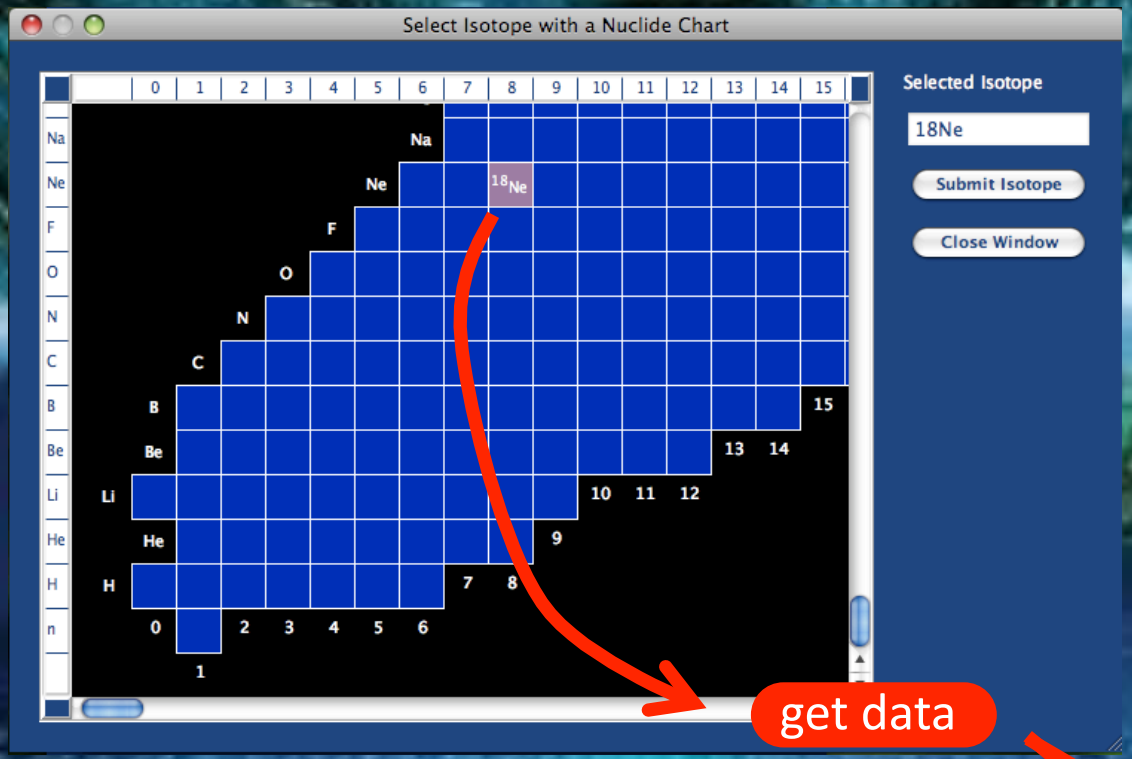






- AUTOMATE THESE REPETITIVE DATA SEARCHES AND RETRIEVALS TO INCREASE PRODUCTIVITY

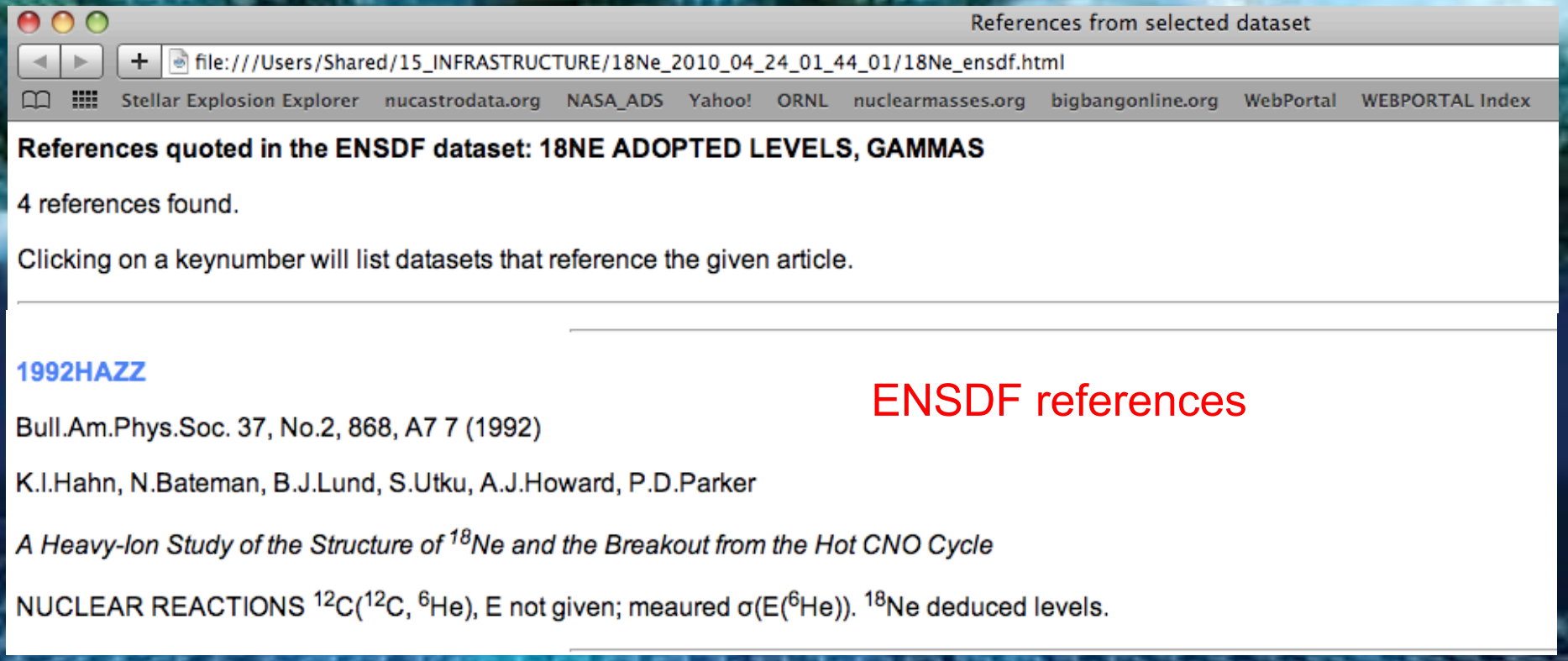
data harvesting



retrieve info from international databases

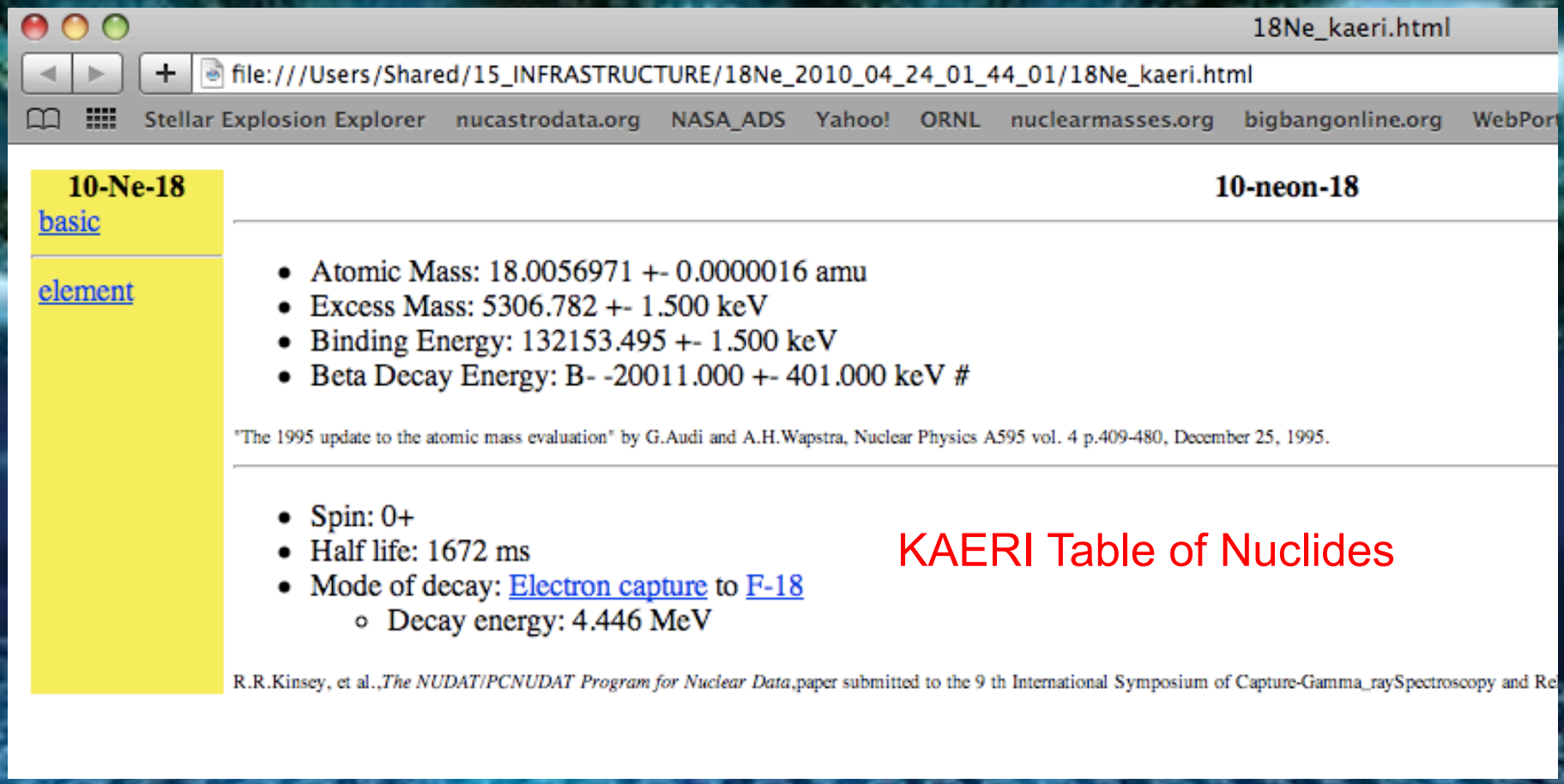
- WE BUILT A "DIGITAL ASSISTANT"
- CHOOSE THE NUCLEUS, IT SEEKS & RETRIEVES (HARVESTS) THE DATA
- DELIVERS TO YOUR DESKTOP / PRIVATE SPACE

data harvesting



- PROOF OF PRINCIPLE TOOL CREATED, SUCCESSFULLY TESTED, & PUT ONLINE
- HARVESTS FROM 5 DATABASES, MANY MORE TO BE ADDED SOON

data harvesting



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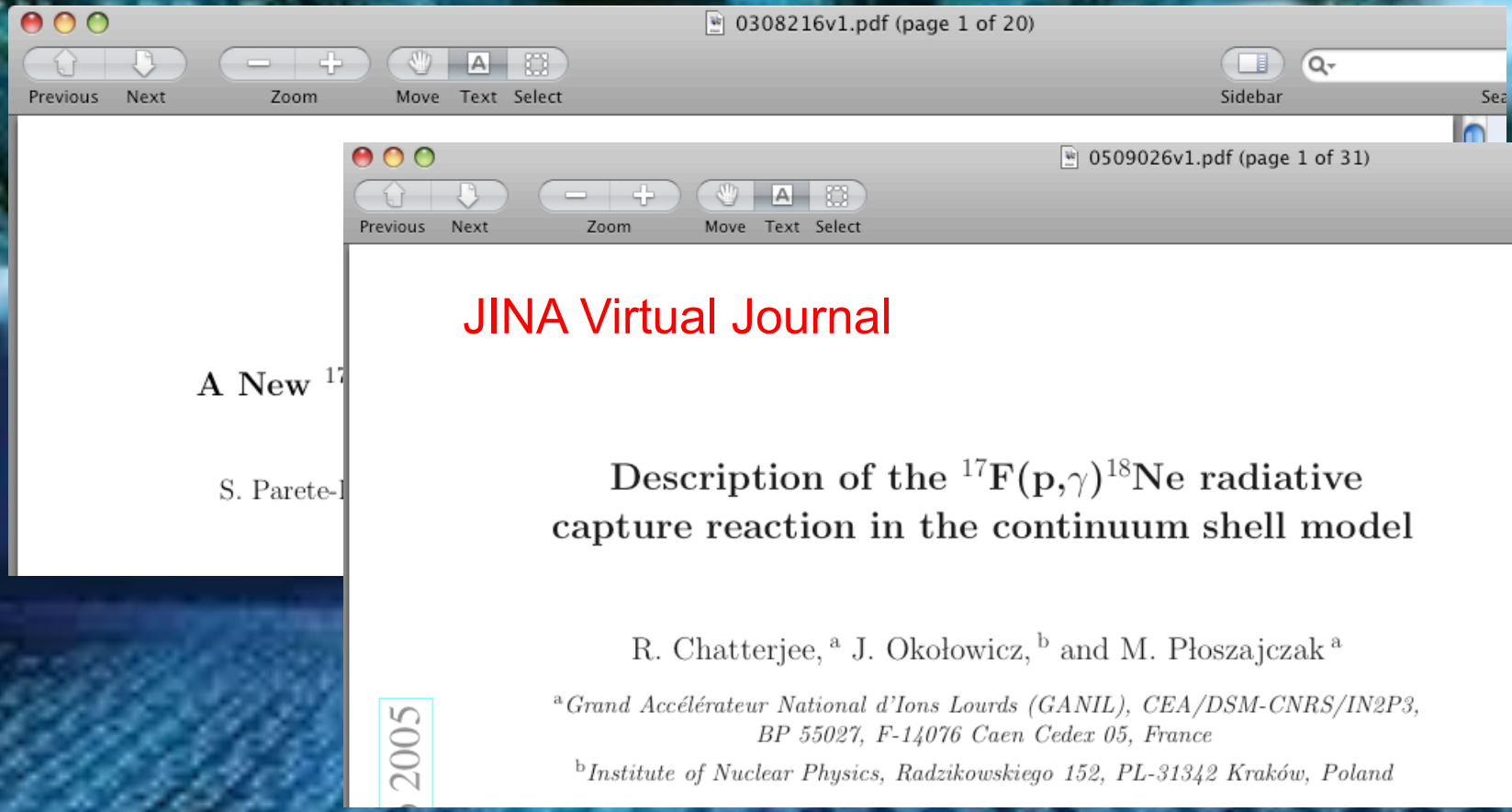
data harvesting



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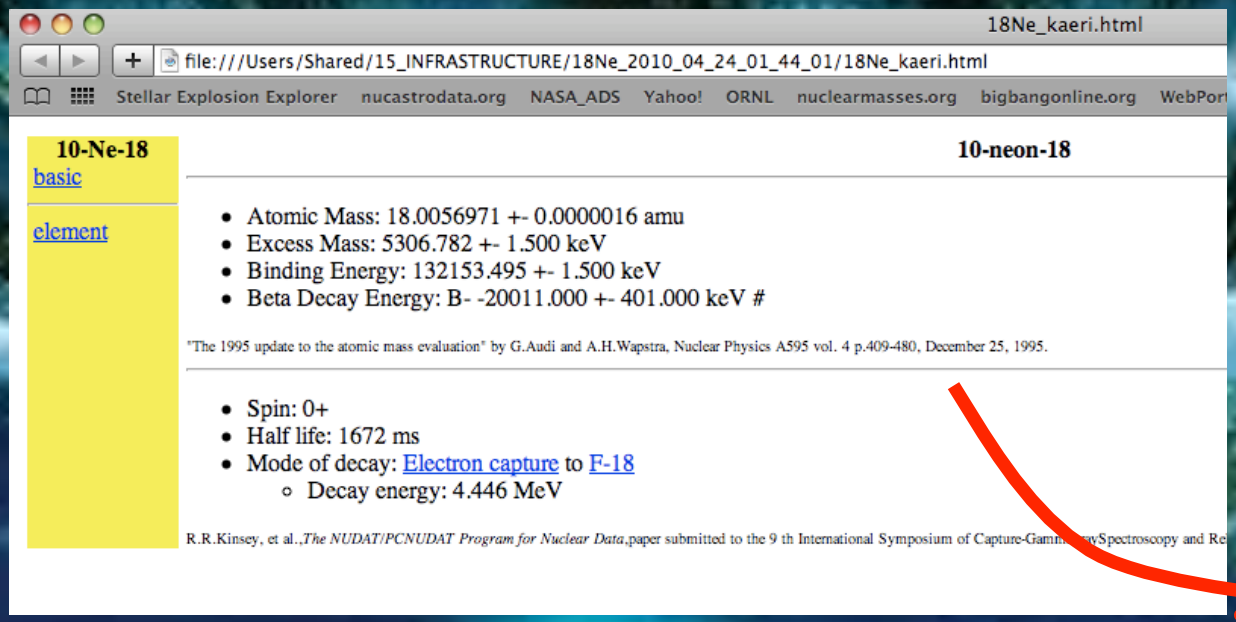
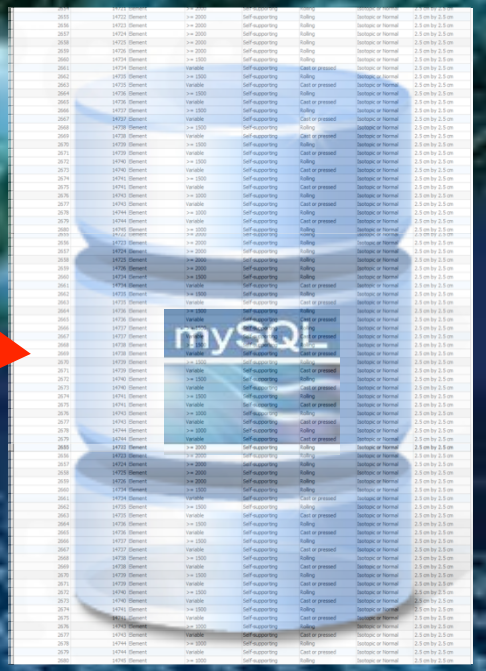
data harvesting





- FUTURE VERSIONS WILL:
  - PARSE SOME INFORMATION INTO A PRIVATE, SECURE, SEARCHABLE DATABASE & FILE SYSTEM
  - LET YOU CHOOSE THE DATABASES
  - INTERFACE WITH TOOLS FOR FILE MANAGEMENT, MERGING, MODIFICATION, CUSTOM VISUALIZATION

near term future …

1. $^{18}Ne(\beta^+)^{18}F$ $Q_m = 4.446$

The half-life of ^{18}Ne is 1672 ± 8 msec: see (78AJ03) and (AD83A). The decay is primarily to $^{18}F^*(0, 1.04, 1.70)$. In addition there is an extremely weak branch [$(2.07 \pm 0.28) \times 10^{-3}$%] to $^{18}F^*(1.08)$ [$J^\pi = 0^-$; T = 0] (AD83A): see Table 18.21 (in PDF or PS) for the parameters of the decay. The parity mixing in the $^{18}F^*(1.04, 1.08)$ $0^+ - 0^-$ doublet has been studied by (AD83A). See also (HE82B). For the earlier work see, in particular, (AD81, HA81B). See also (AD83B, AD83C, AD83D, AD84D, AD85D, BR85K) and (HA84I, BR86Y, HA86FF, TO86G, KI87C; theor.).

2. $^{16}O(^3He, n)^{18}Ne$ $Q_m = -3.196$

^{18}Ne evaluation

See Table 18.24 (in PDF or PS). See also (83AJ01).

(Ajzenberg-Seolve 1987)

3. $^{16}O(^{10}B, ^8Li)^{18}Ne$ $Q_m = -18.951$

At $E(^{10}B)$ = 100 MeV the angular distribution to $^{18}Ne^*(3.38)$ [$(d_{5/2})^2\ 4^+$ state] which is preferentially populated has been studied. $^{18}Ne^*(1.89)$ is also observed. See (83AJ01). See also (OS83E; theor.).

4. $^{18}O(\pi^+, \pi^-)^{18}Ne$ $Q_m = -6.101$

TUNL

1. $^{18}Ne(\beta^+)^{18}F$ $Q_m = 4.446$

2. $^{16}O(^3He, n)^{18}Ne$ $Q_m = -3.196$

3. $^{16}O(^{10}B, ^8Li)^{18}Ne$ $Q_m = -18.951$

4. $^{18}O(\pi^+, \pi^-)^{18}Ne$ $Q_m = -6.101$

- EVALUATION TEMPLATES
  - CHOICES OF DIFFERENT TEMPLATE FORMATS
  - ENABLE TEMPLATE CUSTOMIZATION [GOOGLE APPS…]
  - AUTOMATICALLY POPULATE TEMPLATE WITH HARVESTED INFORMATION

near term future …

ANL/TD/RP--90090

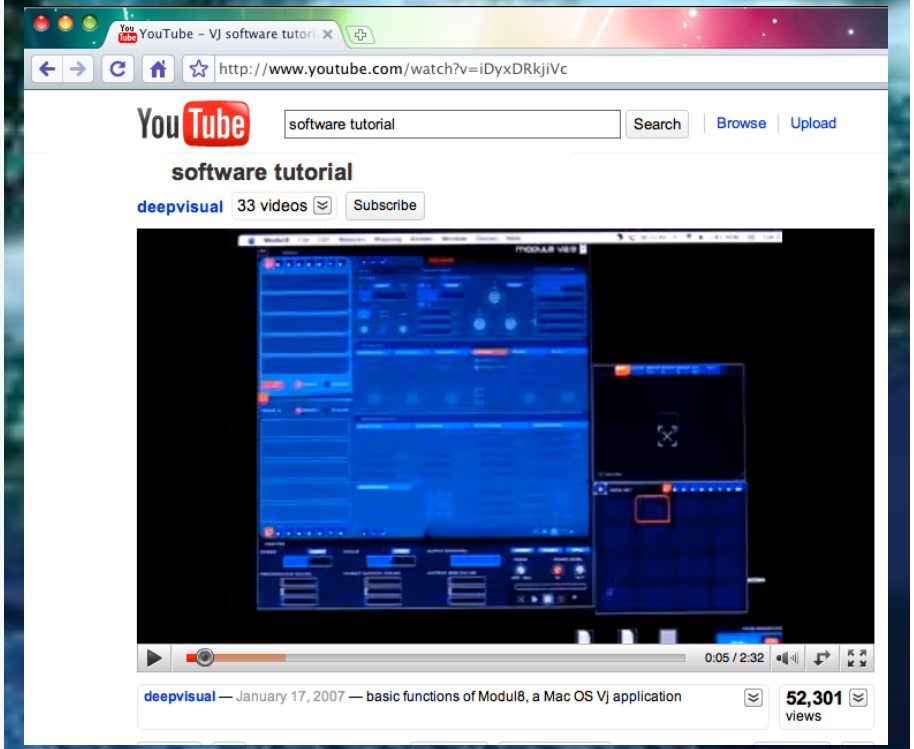
SOME GUIDELINES FOR THE EVALUATION OF NUCLEAR DATA

Donald L. Smith
Technology Development Division
Argonne National Laboratory
Argonne, Illinois 60439

March 20, 1996

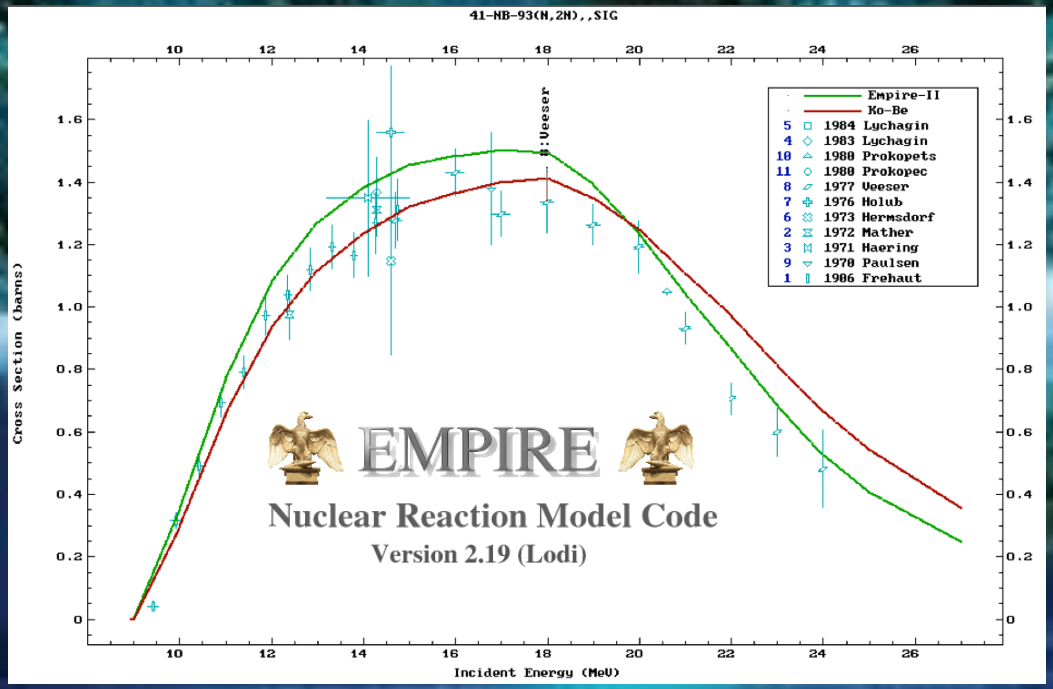
Introduction

Modern data evaluation methodology draws upon basic principles from statistics. It differs from earlier *ad hoc* approaches which are completely subjective (e.g., eye guides to data) or are objective in a limited sense (e.g., combinations of reported data by a simple least-squares procedure without regard to correlations in the data errors or a careful scrutiny of the data included in the evaluation). In addition to utilizing more rigorous mathematical procedures, modern evaluation methodology involves taking great care to insure that the data which are being evaluated are equivalent to what has been assumed in the evaluation model and that the values are consistent with respect to the use of standards and other fundamental physical parameters. This short memorandum cannot substitute for more comprehensive treatments of the subject such as can be found in the listed references. The intent here is to provide an overview of the topic and to impress upon the reader that the evaluation of data of any sort is not a straightforward enterprise. Certainly evaluations cannot be carried out automatically with computer codes without considerable intervention on the part of the evaluator.



- EVALUATION GUIDES
  - INTERACTIVE ONLINE "HELP DESK"
  - HELP TRAIN NEXT GENERATION OF EVALUATORS
  - CAPTURE EXISTING EXPERTISE
  - UTILIZE SOCIAL MEDIA [YOUTUBE …], PAPERS, TALKS…
  - CLOSELY COUPLE TO "CLOUD" EVALUATION TOOLS

longer term future …



CDCC

≠ 0: Print out the $f(m'M' : mM;\theta)$ for each angle θ on file 57 for partition PEL, after the following information:

Fresco

Coupled Reaction Channels Calculations

www.fresco.org.uk

```
card A: (F10.4,3F8.4                                              ergy
card B: (4f8.4)                                                   valence
card C: (4f8.4)
card D: (4A8)
card E: (4f8.1)        Jp,Jt,Jc,Jv              g.s. spins
card F: (4i8)          Pp,Pt,Pc,Pv              g.s. parities
card G: (4I4)          NBINS,NKMAX,NEXB,NNJMAX  no. CDCC bins, max NK,
                                                no. excited states, max(2*Jex+1)
card H: (I4,2f8.4)     NANGL,THMIN,THINC        (cm angular range from Card 3)
for each of the NBINS bins:
 card I:(i2,2f4.1,3f8.4,2i4)
        l,j,Emid,kmin,kmax,NK,KN,ISC
          l,j: quantum numbers  (s==Jv)
          Emid:  centre of bin with respect to continuum threshold
          kmin,kmax,NK: Min,max and number of k values in bin integral
          KN:  original KN index for bin state
          ISC:  normalisation used for bin
    for each IK=1,NK
```

- HOPEFULLY MORE ONLINE TOOLS TO
  - SHARE / MANIPULATE / VISUALIZE DATA
  - AUTOMATE OF REPETITIVE TASKS
  - RUN YOUR CUTTING EDGE NUCLEAR SCIENCE CODES

exploring nuclear data in the clouds

- WOULD LIKE TO EXPLORE THE TREMENDOUS POTENTIAL OF ONLINE SYSTEMS FOR NUCLEAR DATA
- GREAT TO SHARE IDEAS, CODES, MECHANISMS TO BRING NEW "NUCLEAR CLOUD" SYSTEMS ONLINE

nuclear data cloud computing consortium

- SUGGEST FORMING A WORKING GROUP – NUCLEAR DATA CLOUD COMPUTING CONSORTIUM NDC3
- EMAIL "CLOUD @ NUCASTRODATA.ORG" TO JOIN

summary

- AN ONLINE APPROACH – "CLOUD COMPUTING" – PROVIDES MANY ADVANTAGES OVER TRADITIONAL DATA WORK
- THIS "WAVE OF THE FUTURE" ALREADY HAS STREAMLINED INCORPORATION OF LATEST DATA INTO ASTRO CODES
- COULD BE VERY USEFUL FOR YOUR WORK